CHAPTER 6

MAJOR WATER QUALITY CONCERNS AND RECOMMENDED MANAGEMENT STRATEGIES FOR THE CAPE FEAR BASIN

6.1 BASINWIDE MANAGEMENT GOALS

The Cape Fear basin has experienced significant population growth and development over the past 20 years, and that growth is expected to continue. This growth is viewed positively by businesses, local governments and others, but as the population continues to grow, so do the demands on the basin's water resources. For example, water usage through public water suppliers (e.g. local governments and water and sewer authorities) is predicted to double the 1992 usage by the year 2020. This will likely result in an attendant increase in the volume of wastewater that will need to be treated. In addition, land development accompanying population increases will generate additional nonpoint source pollution.

Chapter 4 has documented that many streams, lakes and estuarine areas in the basin are impaired or threatened. Excessive nutrients, sedimentation and limited waste assimilative capacity for oxygen-consuming wastes are major concerns. Continued population growth and development will only exacerbate these problems. Effective point and nonpoint source control measures are needed.

The long-range goal of basinwide management is to provide a means of addressing the complex problems of protecting uses of the Cape Fear Basin's surface waters while accommodating population increases and reasonable economic growth.

In striving towards the long-range goal stated above, NCDWQ's highest priority near-term goals will be as follows:

- identify and restore the most serious water quality problems in the basin (**Section 6.2.1**).
- protect those waters known to be of the highest quality or supporting biological communities of special importance (**Section 6.2.2**) and
- manage problem pollutants, particularly biochemical oxygen demanding wastes (BOD), nutrients, sedimentation and toxics in order to protect those waters currently supporting their uses and allow for reasonable economic growth. (**Sections 6.2.3 and 6.3 through 6.9**).

6.2 MAJOR WATER QUALITY CONCERNS AND PRIORITY ISSUES

6.2.1 Identifying and Restoring Impaired Waters

Identification and restoration of impaired waters is a primary goal of the state's water quality program and basinwide management approach. *Impaired waters* are those identified in Figure 4.19 of Chapter 4 as being rated partially supporting or not supporting their designated uses. Impairment may be based on monitored or evaluated data (see Section 4.4). *Monitored* streams are those based on biological or chemical data collected between 1989 and 1994. *Evaluated* streams are those that are based on data collected prior to 1989 or on best professional judgment. Monitored streams will receive higher priority for management strategy development and grant funding for nonpoint source controls than evaluated streams since the ratings are based on more recent and reliable data. Where water quality problems have been identified but the source(s) is not evident, investigation of the source(s) will be necessary before any specific actions can be outlined.

Nonpoint Source Measures

Table 6.1 lists all monitored freshwater streams in the basin identified as impaired. Also included on the list are highly valued resource waters which are targeted for protection and discussed under Section 6.2.2, below. Together these streams comprise a list of nonpoint source (NPS) priority waters. The NPS Priority Waters listed in Tables 6.1 and 6.2 and depicted in Figures 6.1a, 6.1b and 6.1c indicate DWQ's recommended priority rating for nonpoint source management of waters under Section 319 of the federal Clean Water Act. Waters have been prioritized in the tables for NPS controls which may be implemented through programs such as Section 319, the NC Agriculture Cost Share Program, the Forest Practice Guidelines Related to Water Quality and many others. They may also be used by the NC Department of Transportation for targeting wetlands mitigation sites. A schedule of priority from high to medium has been established to help direct the resources of the programs so that nonpoint sources problems can be addressed and water can be protected from degradation.

High priority streams:

- monitored streams that have an overall use support rating of "nonsupporting,"
- monitored streams that have a "partial support" rating but have a predicted loading of one or more pollutants that is high,
- streams that are unusually sensitive as documented by special studies
  - High Quality Waters
  - Outstanding Resource Waters
  - Water Supply I; Water Supply II; Critical Areas of WS-II, WS-III, WS-IV
  - Shellfish Waters (Class SA) closed due to pollutants and that have a Significant Shellfish Resource (SSR) as identified by the Division of Environmental Health.

Medium priority streams:

Monitored streams that have an overall use support rating of "partially supporting." Shellfish Waters (Class SA) that are closed due to pollutants and that do not have a SSR are also considered medium priority streams.

The United States Fish and Wildlife Service has also identified Unique Aquatic Communities (UAC) that the Division has shown on the maps for NPS targeting. These areas usually encompass waters which provide habitat for threatened and endangered species.

Point Source Measures

Table 6.3 presents management strategies or TMDLs (total maximum daily loads - see Section 5.3) for streams identified as either being impaired by point sources, or streams in which impacts could be expected based on predictive computer modeling. This table presents two types of strategies:

1) those intended to correct existing problems in impaired waters and
2) those being recommended in waters supporting their uses to prevent violation of water quality standards resulting from new or expanding wastewater treatment plant discharges.

The table addresses three types of pollutants: biochemical oxygen demand (BOD), nutrients and toxicants. Streams are listed in upstream to downstream order. More detailed explanations for the rationales of the various strategies are presented in Section 6.3 for oxygen-consuming wastes, 6.4 for nutrients and 6.5 for toxicants. Locations of the recommended strategies listed in Table 6.3 are depicted in Figures 6.2a, 6.2b and 6.2c.

Table 6.1a Nonpoint Source Priority Ratings for Impaired Freshwater Monitored Streams (Page 1 of 2)

NPS Map No.	Name of Stream	Index No.	Miles	Problem Parameter	Potential Sources Subcategory	Reason For Priority *	NPS Priority
1	Little Troublesome Creek	16-7a	2.9	Turb	03	NS	High
3	**UT to Horsepen Creek**	**16-11-5-1-(2)**	**2.9**			**CA, NS**	**High**
4	North Buffalo Creek	16-11-14-1a	8.5	Fecal, NH3(47)	43,01,08, 03	NS	High
	North Buffalo Creek	16-11-14-1b	9.8				High
5	South Buffalo Creek	16-11-14-2b	4.3	NH3(20),Cd(32)		NS	High
	Mile Run Creek	16-11-14-2-4	2.8		43		High
13	Robeson Creek	16-38-(3)a	0.9		10,40	NS	High
14	Third Fork Creek	16-41-1-12-(2)	4.5	Turb(18)	32,40	NS	High
16	Meeting of the Waters	16-41-2-7	1.6		40	NS	High
21	**UT to Polecat Creek**	**17-11-2-(2)**	**1.4**			**CA, NS**	**High**
26	Big Governors Creek	17-32-(.7)	9.5			NS	High
27	Indian Creek	17-35	8.2	Sed	10	NS	High
29	Little Buffalo Creek	17-42	9.8	Sed	50,40	NS	High
31	Loves Creek	17-43-10b	0.9		03,10	NS	High
33	Gulf Creek	18-5-(1)	5.1	Sed	50	NS	High
37	Kenneth Creek	18-16-1-(2)a	1.0		10,30,02	NS	High
45	Little Cross Creek	18-27-4-(1)	7.0			NS	High
46	Pedler Branch	18-31-16	2.6		40,10	NS	High
47	UT#1 to Bones Creek	18-31-24-2a	0.0			NS	High
50	Livingston Creek	18-64b	7.7	NH3(13)		NS	High
52	Northeast Cape Fear River	18-74-(1)a	3.3	DO(39),NH3(15),Cl(20)		NS	High
53	Barlow Branch	18-74-2	1.1		40,01	NS	High
	Panther Creek below Faison UT	18-74-19-3b	3.0		0	NS	High
54	Persimon Branch	18-74-25-1b	0.8			NS	High
56	Burgaw Creek	18-74-39b	10.7	Sed	41,42,62	NS	High
57	HAW RIVER	16-(1)a	7.2		10,08	PS	Medium
58	HAW RIVER	16-(1)d	13.9	Fecal,Turb(20),Cd(16)	10,40,06	PS	Medium
59	Candy Creek	16-5	3.6		10	PS	Medium
60	Little Troublesome Creek	16-7a	2.9			PS	Medium
61	Horsepen Creek	16-11-5-(0.5)	6.9		55,84	PS	Medium
62	South Buffalo Creek	16-11-14-2a	18.6	Sed	43,	PS	Medium
63	Town Branch	16-17	4.0	Fecal,Turb(13)		PS	Medium
64	Robeson Creek	16-38-(3)b	4.7	pH(12),Chla(20)	10,40	PS	Medium
65	Bolin Creek	16-41-1-15-1-(4	1.0			PS	Medium
66	Northeast Creek	16-41-1-17-(7)a	2.2		30,40	PS	Medium
67	Northeast Creek	16-41-1-17-(7)b	1.8	Turb(14),Cu(14),Sed	43, 03	PS	Medium
68	Northeast Creek	16-41-1-17-(7)c	4.4	Sed	43	PS	Medium
69	Morgan Creek	16-41-2-(5.5)	8.0	Sed	43, 02	PS	Medium
70	East Fork Deep River	17-2-(.3)	6.5	Turb(11)	10,08	PS	Medium
71	DEEP RIVER	17-(4)a	2.0		40	PS	Medium
72	DEEP RIVER	17-(4)b	6.8	Turb(14)	10,30,40	PS	Medium
73	DEEP RIVER	17-(4)d	2.3	Turb(13),Cu(13),Hg(13), F	18,20	PS	Medium
74	Richland Creek	17-7	9.1	Turb(11),Cu(16)	62,02	PS	Medium
75	Haskett Creek	17-12a	5.5			PS	Medium
76	Haskett Creek	17-12b	2.3	Cu(33)	40	PS	Medium
77	Flat Creek	17-24	9.5		18,20	PS	Medium
78	Cotton Creek	17-26-5-3-(1)a	0.3		03,	PS	Medium
79	Cotton Creek	17-26-5-3-(1)b	6.5		10,40,	PS	Medium
80	Falls Creek	17-27	11.6	Sed	10	PS	Medium
81	McLendons Creek	17-30b	20.1			PS	Medium
82	Richland Creek	17-30-5-(2)	12.8			PS	Medium
83	Little Pocket Creek	17-37-4	12.4		11,12	PS	Medium
84	Cedar Creek	17-39	7.9	Sed	50	PS	Medium
85	Georges Creek	17-41	8.7			PS	Medium
86	Rocky River	17-43-(8)a	4.2			PS	Medium
87	Loves Creek	17-43-10a	5.5		10	PS	Medium
88	Bear Creek	17-43-16a	14.9	Sed		PS	Medium
89	Neill Creek (Neals Creek)	18-16-(.7)	2.4	Sed		PS	Medium
90	Kenneth Creek	18-16-1-(2)b	5.5		10,30	PS	Medium
91	Anderson Creek	18-23-32	5.5	Sed	10	PS	Medium
92	Cross Creek	18-27-(1)	9.0	Sed		PS	Medium
93	Cross Creek	18-27-(3)	3.6	Pb(13)	40	PS	Medium
94	Harrisons Creek	18-42	20.5	pH(100), Sed	90	PS	Medium
95	Turnbull Creek	18-46	27.2	pH(100), Sed	10	PS	Medium
	CAPE FEAR RIVER near Acme	18-(63)a	2.1		0	PS	
96	Livingston Creek	18-64a	14.5			PS	Medium
97	South River	18-68-12a	7.2			PS	Medium
98	Little Black River	18-68-12-1a	20.0	Sed	10	PS	Medium

Table 6.1a Nonpoint Source Priority Ratings for Impaired Freshwater Monitored Streams (Page 2 of 2)

NPS Map No.	Name of Stream	Index No.	Miles	Problem Parameter	Potential Sources Subcategory	Reason For Priority *	NPS Priority
99	Northeast Cape Fear River	18-74-(1)b	2.6	Sed	82,	PS	Medium
100	Goshen Swamp	18-74-19	32.6	Sed	10,16	PS	Medium
101	Herrings Marsh Run	18-74-19-16	1.8			PS	Medium
102	Limestone Creek	18-74-23	7.5	Sed	74,18	PS	Medium
103	Persimon Branch	18-74-25-1a	1.5			PS	Medium
104	Rock Fish Creek	18-74-29c	7.2	Cu(16),Sed	11,18,03	PS	Medium
105	Cypress Creek	18-74-55-2	8.0		65	PS	Medium

*REASON FOR PRIORITY		POTENTIAL SOURCES SUB CATEGORY CODES	
CA	Water Supply Watershed Critical Area	0 to 09	Point Sources (01=industrial, 02&03 municipal, 08 minor non-munic)
HQ	High Quality Waters	10 to19	Agriculture
NS	Nonsupporting waters based on monitored data	20 to 29	Silviculture
ORW	Outstanding Resource Waters	30 to 39	Construction
PS	Partially Supporting waters based on monitored data	40 to 49	Urban Runoff
UAC	USFWS Unique aquatic community	50 to 59	Resource Extraction (i.e., mining)
WS-I	Water Supply I Watershed	60 to 69	Land Disposal (Runoff/Leacheate from Permitted areas)
WS-II	Water Supply II Watershed	70 to 79	Hydrologic/Habitat Modification
BOLD	These streams identified for special emphasis	80/90	80=Other (82=waste storage/tank leaks, 84=spills) 90=unknown

Table 6.1b Priority Nonpoint Source Ratings of High Value Resource Waters in the Cape Fear Basin (Page 1 of 3)

NPS Map No.	Name of Stream	Index No.	Miles	Problem Parameter	Potential Sources Subcategory	Reason For Priority *	NPS Priority
1	Troublesome Creek WS	16-6-(0.7)	5.8	Sed	10	CA	High
	Glady Creek	16-6-1-(2)	0.5		90	CA	High
2	Reedy Fork WS	16-11-(3.5)	12.3	Sed	06	CA	High
	Brush Creek (Lake Higgins)	16-11-4-(2)	0.6		10	CA	High
3	**UT to Horsepen Creek**	**16-11-5-1-(2)**	**2.9**			**CA, NS**	**High**
	Horsepen Creek	16-11-5-(2)	1.6		55,84	CA	High
	Long Branch	16-11-6-(2)	0.5			CA	High
	Richland Creek	16-11-7-(2)	1.7			CA	High
	Squirrel Creek	16-11-8-(2)	2.3			CA	High
6	Stony Creek (Lake Burlington) WS	16-14-(1)	12.1			WS-II	High
	Grays Branch	16-14-2	4.1		11	WS-II	High
	Benton Branch	16-14-3	6.5		11	WS-II	High
	Toms Creek	16-14-4	5.7		11	WS-II	High
	Buttermilk Creek	16-14-5	9.6			WS-II	High
	Jones Creek	16-14-5-1	2.0			WS-II	High
	Laughin Creek	16-14-5-2	4.5			WS-II	High
	Whittie Creek	16-14-5-3	2.7			WS-II	High
	Stony Creek (Stony Cr Res.)	16-14-(5.5)	4.1			WS-II, CA	High
	Jordan Creek	16-14-6-(0.5)	10.9		11	WS-II	High
	Hughes Mill Creek	16-14-6-1	3.8		11	WS-II	High
	Owens Creek	16-14-6-2	6.7		11	WS-II	High
	Jordan Creek	16-14-6-(3)	0.7		11	WS-II, CA	High
	Mine Creek	16-14-7-(1)	3.7			WS-II	High
	Mine Creek	16-14-7-(2)	0.6			WS-II, CA	High
	Deep Creek	16-14-8-(1)	6.5			WS-II	High
	Deep Creek	16-14-8-(2)	0.7			WS-II, CA	High
7	Back Creek (Graham Lake) WS	16-18-(1)	8.0			WS-II	High
	Back Creek (Graham Lake)	16-18-(1.5)	5.7			WS-II, CA	High
	Stagg Creek	16-18-2-(0.5)	6.7			WS-II	High
	Frank Creek	16-18-2-1	2.5			WS-II	High
	Stagg Creek	16-18-2-(2)	0.5			WS-II, CA	High
	Mill Creek	16-18-3-(0.5)	4.2			WS-II	High
	Lake Michael	16-18-3-1	3.9			WS-II	High
	Mill Creek	16-18-3-(1.5)	0.8			WS-II, CA	High
	Unnamed Trib Forest Lake	16-18-3-2-(1)	1.0			WS-II	High
	Unnamed Trib Forest Lake	16-18-3-2-(2)	0.4			WS-II, CA	High
	Quaker Creek	16-18-4-(1)	6.3			WS-II	High
	Quaker Creek	16-18-4-(2)	0.6			WS-II, CA	High
	Scrub Creek	16-18-4-1-(1)	3.0			WS-II	High
	Scrub Creek	16-18-4-1-(2)	0.7			WS-II, CA	High
	Otter Creek	16-18-5-(1)	2.7			WS-II	High
	Otter Creek	16-18-5-(2)	0.8			WS-II, CA	High
8	Big Alamance Creek WS	16-19-(2.5)	9.7			WS-II, CA	High
	Little Alamance Creek	16-19-3-(4.5)	0.5	Sed	10	WS-II, CA	High
	Rock Creek	16-19-3-5-(2)	1.0		10	WS-II, CA	High
	Beaver Creek	16-19-4-(2)	0.7			WS-II, CA	High
9	Cane Creek WS	16-27-(1)	4.1			WS-II	High
	Hog Branch	16-27-2	1.6			WS-II	High
	Cane Creek	16-27-(2.5)	4.7			WS-II, CA	High
	Turkey Hill Creek	16-27-3-(1)	5.2			WS-II	High
	Turkey Hill Creek	16-27-3-(2)	0.3			WS-II, CA	High
	Watery Fork	16-27-4-(0.5)	2.1			WS-II	High
	Hudson Branch	16-27-4-1	0.7			WS-II	High
	Watery Fork	16-27-4-(2)	0.6			WS-II, CA	High
	Toms Creek	16-27-5-(1)	3.0			WS-II	High
	Toms Creek (Apple Pond)	16-27-5-(2)	0.9			WS-II, CA	High
	Caterpillar Creek	16-27-6-(1)	1.0			WS-II	High
	Caterpillar Creek	16-27-6-(2)	1.5			WS-II, CA	High
	Collins Creek	16-30-(1.5)	3.9	Sed	10	WS-IV, CA	High
10	HAW RIVER	16-(36.3)	0.5		10,40	CA	High
11	HAW RIVER	16-(37.3)	0.5			CA	High
12	HAW RIVER (Jordan Lake) WS	16-(37.5)	2.8			CA	High
13	Robeson Creek	16-38-(5)	0.3			CA	High
	Stinking Creek	16-39-(2)	0.8			CA	High
	Kirks Creek	16-40	3.2			CA	High
	New Hope River Arm of Jordan Lake	16-41-(0.5)	0.0			CA	High
14	New Hope Creek	16-41-1-(14)	4.8		43	CA	High
	Little Creek	16-41-1-15-(3)	0.7	Sed		CA	High
	Crooked Creek	16-41-1-16-(2)	0.7	Sed	10,30	CA	High

Table 6.1b Priority Nonpoint Source Ratings of High Value Resource Waters in the Cape Fear Basin (Page 2 of 3)

NPS Map No.	Name of Stream	Index No.	Miles	Problem Parameter	Potential Sources Subcategory	Reason For Priority *	NPS Priority
14	Northeast Creek	16-41-1-17-(4)	0.9	Sed	43	CA	High
	Indian Creek	16-41-1-18-(2)	0.6			CA	High
	Morgan Creek (including	16-41-2-(9.5)	0.6			CA	High
	Cub Creek	16-41-2-10-(2)	0.6		08		High
	Lick Creek	16-41-2.5-(2)	0.7			CA	High
	Folkner Branch	16-41-3-(2)	0.5			CA	High
	Bush Creek	16-41-4-(.7)	0.5			CA	High
	Hendon Creek	16-41-4-1-(2)	0.6			CA	High
	Overcup Creek	16-41-4-2-(2)	0.4			CA	High
	Beartree Creek	16-41-5-(2)	0.7			CA	High
	White Oak Creek	16-41-6-(3.5)	0.5	Sed	65,32,08	CA	High
	Rocky Ford Branch	16-41-6-4-(2)	0.6		10	CA	High
	Mill Branch	16-41-6-5-(2)	0.5		90	CA	High
	Parkers Creek	16-41-8-(2)	0.5			CA	High
	Windfall Branch	16-41-9-(2)	0.5			CA	High
	Beaver Creek	16-41-10-(2)	0.6	Sed		CA	High
	Little Beaver Creek	16-41-11-2-(2)	0.6			CA	High
	Weaver Creek	16-41-12-3-(2)	0.5			CA	High
15	Morgan Creek WS	16-41-2-(1)	6.7			WS-II	High
	Morgan Creek (University Lake)	16-41-2-(1.5)	1.3			WS-II, CA	High
	Phils Creek	16-41-2-2-(0.3)	5.0			WS-II	High
	Phils Creek	16-41-2-2-(0.7)	0.7			WS-II, CA	High
	Neville Creek	16-41-2-2-1-(1)	3.0			WS-II	High
	Neville Creek	16-41-2-2-1-(2)	0.5			WS-II, CA	High
	Mill Creek	16-41-2-3-(.5)	2.5			WS-II	High
	Cumbo Creek	16-41-2-3-1	0.8			WS-II	High
	Mill Creek	16-41-2-3-(2)	0.5			WS-II, CA	High
	Price Creek	16-41-2-4	0.4			WS-II, CA	High
	East Branch Price	16-41-2-4-1-(1)	2.4			WS-II	High
	East Branch Price	16-41-2-4-1-(2)	0.2			WS-II, CA	High
	West Branch Price	16-41-2-4-2-(1)	2.4			WS-II	High
	West Branch Price	16-41-2-4-2-(2)	0.3			WS-II, CA	High
18	DEEP RIVER WS	17-(1)	2.7		10,30,40,	CA	High
	East Fork Deep River	17-2-(.7)	0.6		10,08	CA	High
	Long Branch	17-2-1-(2)	0.6			CA	High
19	West Fork Deep River WS	17-3-(.7)	3.1			CA	High
	Hiatt Branch	17-3-1-(2)	0.6		11	CA	High
	Boulding Branch	17-3-2	3.7		30,40,11	CA	High
	West Fork Deep River	17-3-(3)	1.1			CA	High
	UT to West Fork Deep River	17-3-0.5b	3.3			CA	High
20	DEEP RIVER WS	17-(3.7)	1.3		40	CA	High
21	**UT to Polecat Creek**	**17-11-2-(2)**	**1.4**			**CA, NS**	**High**
22	Little Polecat Creek	17-11-3	6.3		32	HQW	High
23	Polecat Creek WS	17-11-(11.5)	2.2			CA	High
	Bull Run	17-11-4b	0.7			CA	High
24	Sandy Creek	17-16-(3.5)	0.6			CA	High
25	DEEP RIVER	17-(25.7)	12.8		11,03	HQW	High
	DEEP RIVER	17-(28.5)	14.4		11,12,31,32,43	HQW	High
28	DEEP RIVER	17-(36)	0.5			CA	High
30	Rocky River	17-43-(7.5)	0.6			CA	High
32	CAPE FEAR RIVER	18-(4.5)	0.5		11,12,31,32	CA	High
	Gulf Creek	18-5-(2)	0.2	Sed	50	CA	High
34	Parkers Creek	18-9	8.4			HQW	High
35	Avents Creek	18-13	8.1			HQW	High
36	Hector Creek	18-15	9.7			HQW	High
38	CAPE FEAR RIVER	18-(16.3)	0.5		11,12,31,32	CA	High
39	CAPE FEAR RIVER	18-(20.3)	0.6		11,12,31,32,03,(	CA	High
40	Little River HQW	18-23-(1)	13.0			HQW	High
	Little River	18-23-(5)	1.7			HQW	High
	Little River	18-23-(8)	4.4			HQW	High
	Little River	18-23-(10.3)	0.6			CA, HQW	High
	Little River	18-23-(10.7)	12.8	pH(64)		HQW	High
41	Nicks Creek	18-23-3-(1.5)	0.6		90	CA	High
42	Little River	18-23-(23.5)	1.5		11	CA	High
43	CAPE FEAR RIVER	18-(25.5)	0.5		11,12,31,32	CA	High
44	Cross Creek	18-27-(2.5)	0.5	Sed		CA	High
	Little Cross Creek	18-27-4-(1.5)	0.5			CA	High
48	CAPE FEAR RIVER	18-(58.5)	0.6		90	CA	High
49	CAPE FEAR RIVER	18-(62.5)	0.5		90	CA	High
51	Black River ORW	18-68	63.1			ORW	High

Table 6.1b Priority Nonpoint Source Ratings of High Value Resource Waters in the Cape Fear Basin (Page 3 of 3)

NPS Map No.	Name of Stream	Index No.	Miles	Problem Parameter	Potential Sources Subcategory	Reason For Priority *	NPS Priority
	Six Runs Creek	18-68-2-(11.5)	10.3			ORW	High
	South River	18-68-12-(8.5)	42.0			ORW	High
55	Northeast Cape Fear River	18-74-(25.5)	17.3			HQW	High
106	Deep River from confluence with Haw River upstream to Coleridge, including tributaries (with special emphasis on Rocky River Subbasin in Chatham Co. and Fork Cr in Randolph Co.		THESE USFWS UAC AREAS ARE SUBJECT TO FUTURE MODIFICATION AND SHOULD ONLY BE CONSIDERED DRAFT AT THIS POINT. (THEY WILL PROBABLY BE NARROWED DOWN)			USFWS UAC	High
107	Haw River from Jordan lake to Saxapahaw					USFWS UAC	High
108	University Lake in Chapel Hill and tributaries					USFWS UAC	Medium
109	Orton Pond, Sand Hill Creek Pond and tributaries					USFWS UAC	Medium
110	Town Creek and tributaries in Brunswick County					USFWS UAC	Medium
111	Black and South River Subbasin					USFWS UAC	Medium

*REASON FOR PRIORITY		POTENTIAL SOURCES SUB CATEGORY CODES	
CA	Water Supply Watershed Critical Area	0 to 09	Point Sources (01=industrial, 02&03 municipal, 08 minor non-munic)
HQ	High Quality Waters	10 to19	Agriculture
NS	Nonsupporting waters based on monitored data	20 to 29	Silviculture
ORW	Outstanding Resource Waters	30 to 39	Construction
PS	Partially Supporting waters based on monitored data	40 to 49	Urban Runoff
UAC	USFWS Unique aquatic community	50 to 59	Resource Extraction (i.e., mining)
WS-I	Water Supply I Watershed	60 to 69	Land Disposal (Runoff/Leacheate from Permitted areas)
WS-II	Water Supply II Watershed	70 to 79	Hydrologic/Habitat Modification
BOLD	These streams identified for special emphasis	80/90	80=Other (82=waste storage/tank leaks, 84=spills) 90=unknown

Table 6.2 Targeted Estuarine Water Bodies for Nonpoint Source Management

Map Number	Area Name	DEH Area	Problem Parameter	Probable Sources	Reason For Priority *	NPS Priority
121	Southport Area	B1	Fecal	P,NP	PS	Medium
106	Polly Gully, Beaverdam, Jump and Run, Calf Gully, and Dutchman's Creek	B1			HQW	High
122	Cape Fear	B4	Fecal	P,NP	PS	Medium
107	Walden Creek	B4			HQW	High
123	Myrtle Sound Area	B5	Fecal	NP	PS	Medium
124	Masonboro Sound Area	B6	Fecal	P,NP	PS	High
108	Masonboro Sound	B6			ORW	High
114	**Whiskey Creek**	**B6**	**Fecal**	**NP**	**PS, SSR**	**High**
125	Wrightsville Beach	B7	Fecal	NP	PS	Medium
109	**Bradley Creek**	**B7**	**Fecal**	**NP**	**HQW, PS**	**High**
110	Topsail and Middle Sounds	B7/B8			ORW	High
115	**Howe Creek**	**B7**	**Fecal**	**NP**	**PS, SSR, ORW**	**High**
117	**Pages Creek**	**B7**	**Fecal**	**NP**	**PS, SSR**	**High**
118	**Futch Creek**	**B7**	**Fecal**	**NP**	**PS, SSR**	**High**
126	Topsail Sound	B8	Fecal	NP	PS	Medium
119	**Virginia Creek**	**B8**	**Fecal**	**NP**	**PS, SSR**	**High**
120	**Mill Creek**	**B8**	**Fecal**	**NP**	**PS, SSR**	**High**
127	Stump Sound	B9	Fecal	P,NP	PS	Medium
112	Stump Sound and Alligator Bay	B9			ORW	High
113	King's Creek	B9	Fecal	NP	HQW	High

^^ Reason For priority
HQW= High Quality Waters
ORW= Outstanding Resource Waters
PS= Partially Supporting Waters
SSR= Significant Shellfish Waters as identified by Division of Environmental Health
Special Emphasis

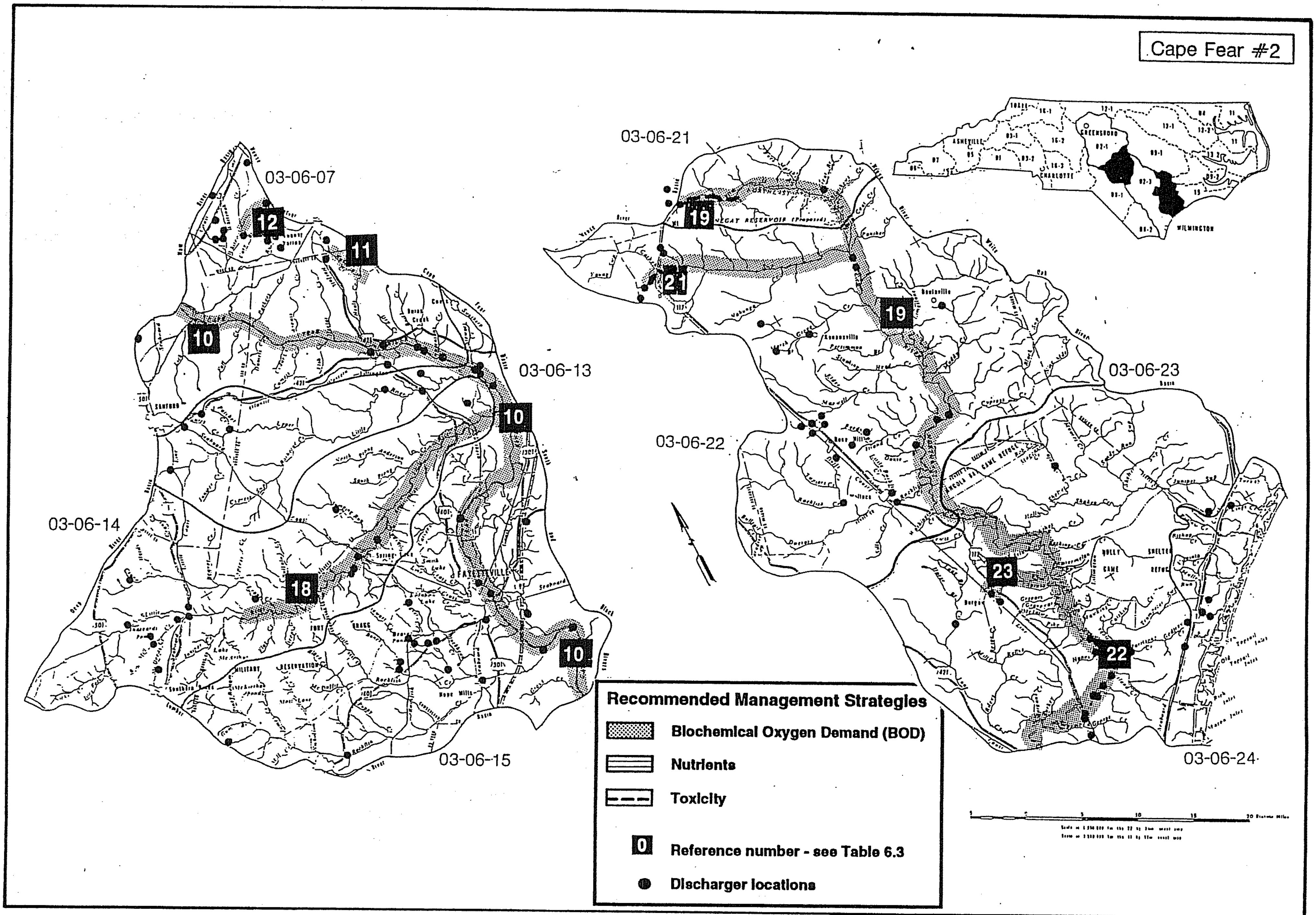

Figure 6.2b Map of Management Strategies for Addressing Biochemical Oxygen Demand (BOD), Nutrients and Toxicity in the Upper and Northeast Cape Fear Watersheds

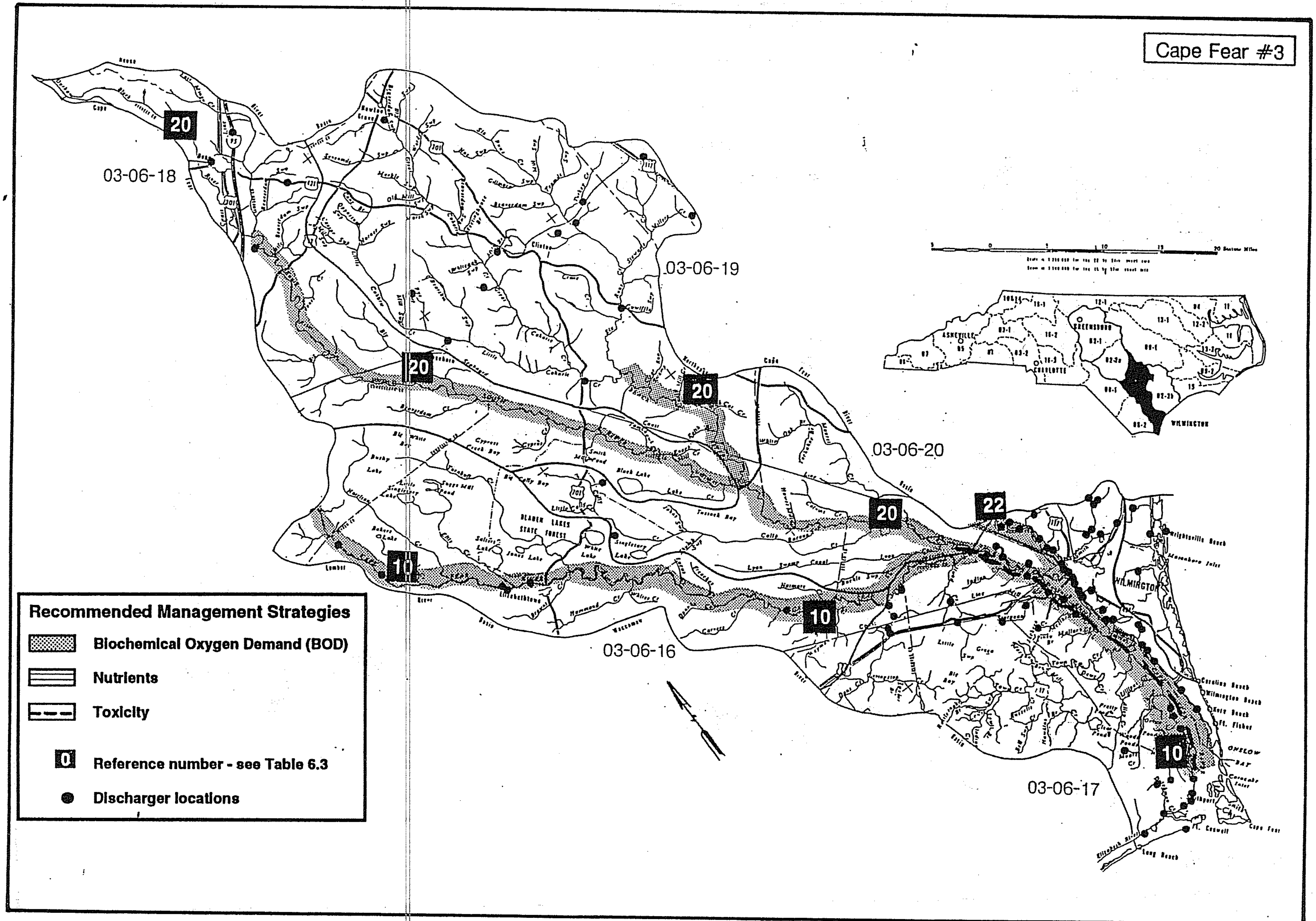

Figure 6.2c Map of Management Strategies for Addressing Biochemical Oxygen Demand (BOD), Nutrients and Toxicity in the Black and Lower Cape Fear Watershed

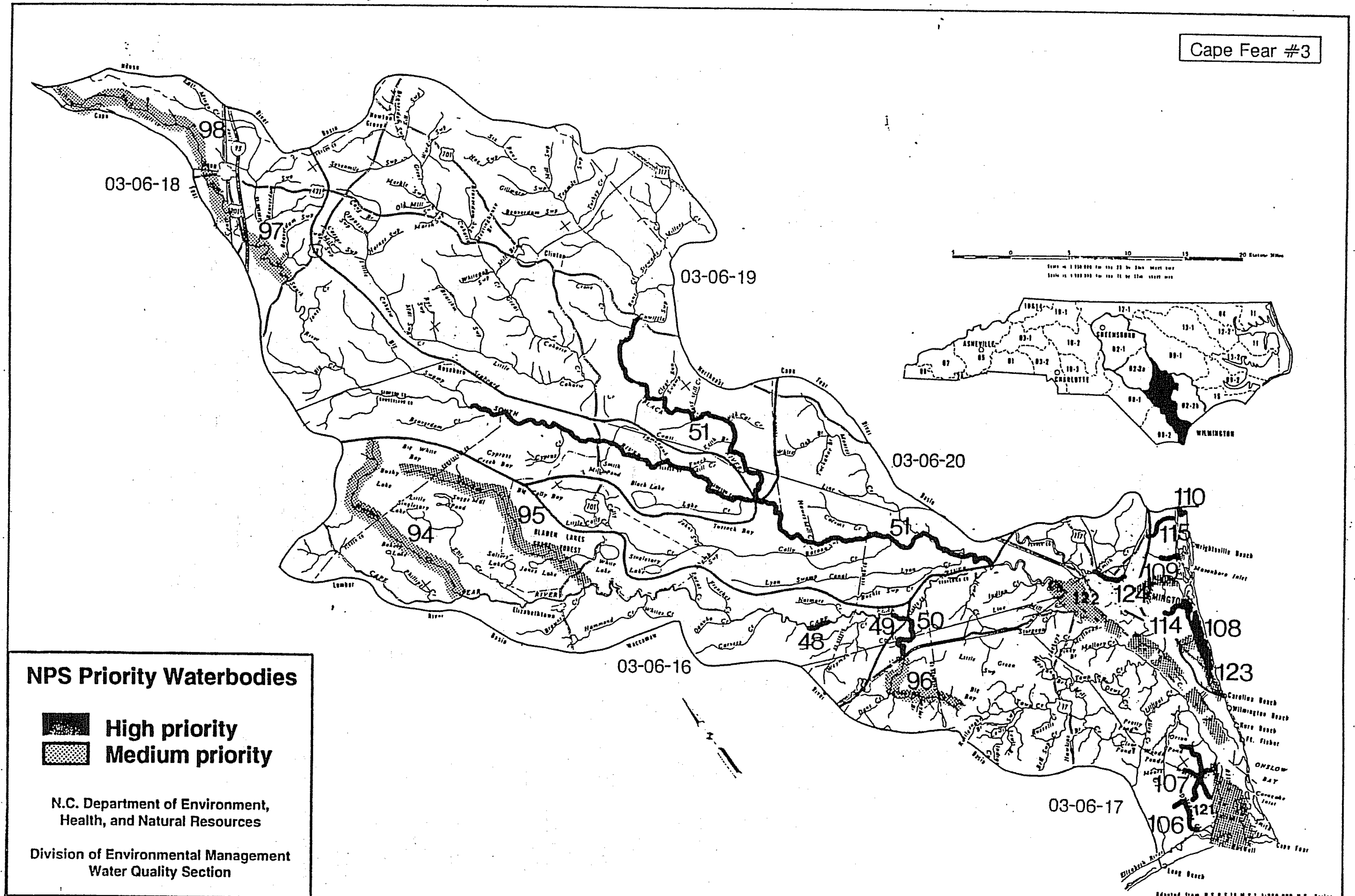

Figure 6.1c Map of Targeted Water Bodies for Nonpoint Source Management in the Black and Lower Cape Fear Watersheds

Table 6.3 Recommended and Existing Management Strategies for Addressing Biochemical Oxygen Demand (BOD), Nutrients and Toxicity

Subbasin	Receiving water	Parameter of Concern	Map Number (Figure 6.2)	Strategy
030601	Haw River	DO	1	C, NSW
	Little Troublesome Ck	DO, Toxics	2	A, NSW, TRE
030602	North Buffalo Ck	DO, Toxics, Nutrients	3	A, NSW, TRE
	South Buffalo Ck	DO, Toxics, Nutrients	3	A, NSW
	Buffalo Creek	DO, Toxics, Nutrients	3	A, NSW
	Reedy Fork	DO, Toxics, Nutrients	3	A, NSW
	Moadams Creek	DO	4	A, NSW
	Back Creek	DO	4	A, NSW
	Haw River	DO, Nutrients, Toxics	5	M, NSW, IN
	Haw Creek	DO	6	IS, NSW
030603	Alamance Creek tribs	DO	7	Z
030604	Robeson Creek	DO	8	IS, A, NSW
030605	New Hope Creek	DO, Nutrients	9	A, NSW
	Northeast Creek	DO, Nutrients	9	A, NSW
	Jordan Lake & tribs	Nutrients	9	NSW
030606	Morgan Creek	DO, Nutrients	9	A, NSW
030607	Cape Fear River	DO	10	E
	Kenneth Creek	DO	11	A
	Utley Creek	DO	12	M
030608	Deep River	DO, Nutrients	13	A, DAM
	East Fork Deep River	Stormwater		TMDL
	Richland Creek	DO, Nutrients	14	A
030609	Deep River	DO, Nutrients	13	D, DAM
	Hasketts Creek	DO	15	A
030610	Deep River	DO, Nutrients	13	D, DAM
	Cotton Creek	DO, Toxics, Fecal	16	Z, TMDL
030611	Deep River	DO, Nutrients	13	D, DAM
030612	Loves Creek	DO, Nutrients	17	A
	Rocky River	DO, Nutrients	17	A
030614	Lower Little River	DO	18	B
030615	Cape Fear River	DO	10	E
030616	Cape Fear River	DO	10	E
030617	Cape Fear River	DO, Toxics	10	E, Variance, IN
030617	Northeast Cape Fear R	DO	19	A
030618	South River	DO	20	ORW, C
030619	Black River	DO	20	ORW, C
030620	Black River	DO	20	ORW, C
030621	Northeast Cape Fear	DO, Toxics	19	A
	Barlow Branch	DO, Toxics	21	A, Variance
030622	Northeast Cape Fear	DO	19	HQW, C
	Panther Branch	DO, Toxics	21	A, Variance
	Goshen Swamp	Toxics	21	Variance
030623	Northeast Cape Fear	DO	22	C
	Burgaw Creek	DO	23	A
	Osgood Canal	DO	23	A

Legend for Table 6.3

Strategy	Description
A	Alternatives analysis required; if no alternatives, [1]advanced tertiary [2]limits for new/expanding.
B	Alternatives analysis required; if no alternatives, 10/4 [2]limits for new/expanding.
C	Alternatives analysis required; if no alternatives, 15/4 [2]limits for new/expanding.
D	Alternatives analysis required; if no alternatives, [1]advanced tertiary [2]limits for new/expanding major facilities above Carbonton Dam; no new discharges below Carbonton Dam.
E	Alternatives analysis required; if no alternatives, [1]advanced tertiary or BAT [2]limits for new/expanding major facilities; 12/2 [2]limits for new/expanding minor facilities.
M	Modeling study required if expansion pursued.
IS	Investigate sources
NSW	Nutrient Sensitive Waters management controls required.
DAM	Under new Dam Safety Regulations, a minimum release may be required to protect aquatic life.
TRE	Toxicity Reduction Evaluation required.
SOC	Special Order by Consent to resolve permit violations.
IN	Interaction between discharges of toxics will be evaluated.
HQW	High Quality Waters Regulations apply.
ORW	Outstanding Resource Waters regulations apply.
Z	Zero flow regulations.

Notes:

1 *Advanced tertiary* is generally defined as 5 mg/l BOD_5 and 2 mg/l NH_3 although more stringent limits could be required for individual facilities where needed to address localized problems. Industries will be evaluated on a case-by-case basis.

2 *Limits* refers to summer limits for BOD_5/NH_3

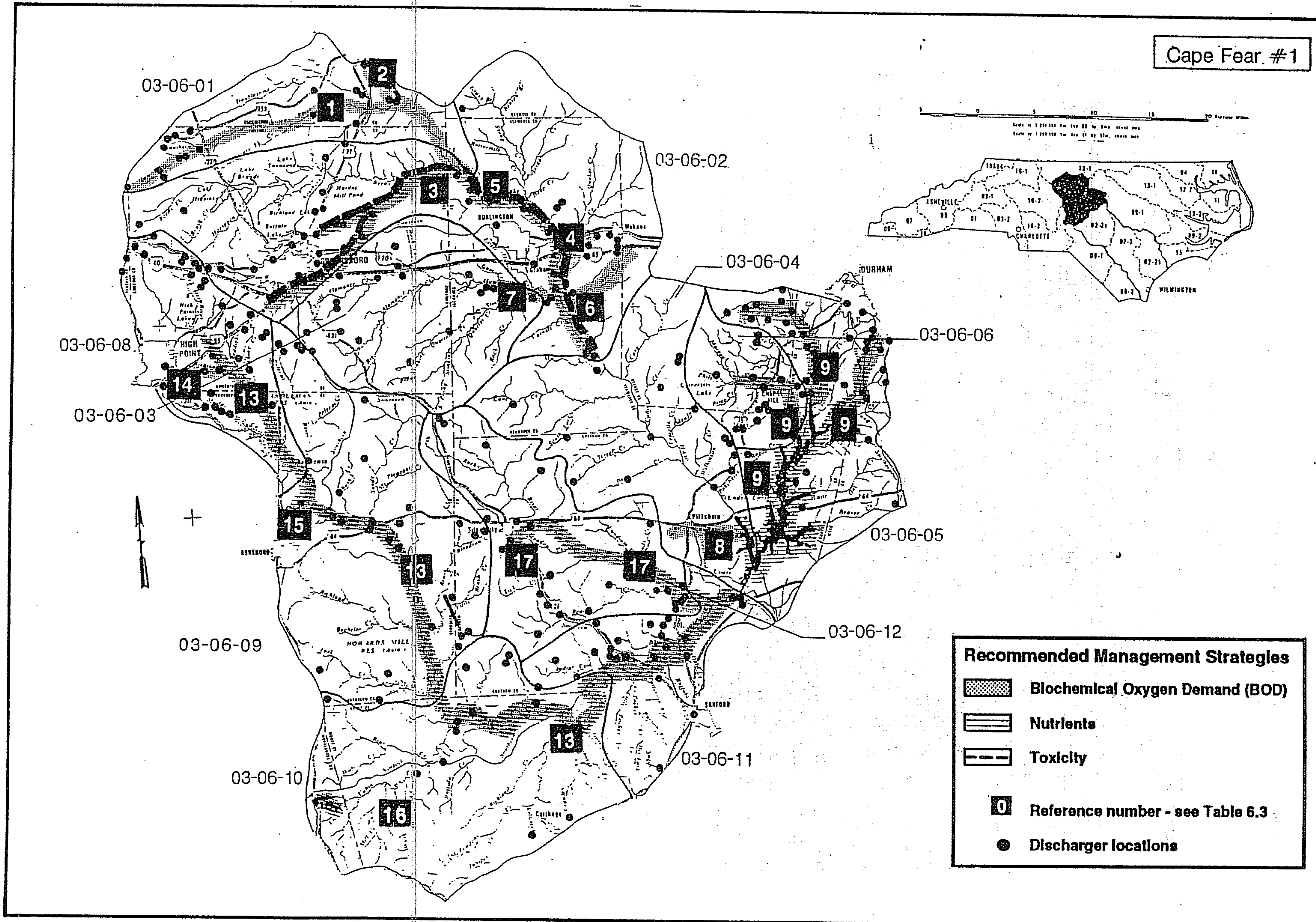

Figure 6.2a Map of Management Strategies for Addressing Biochemical Oxygen Demand (BOD), Nutrients and Toxicity in the Haw and Deep River Watershed

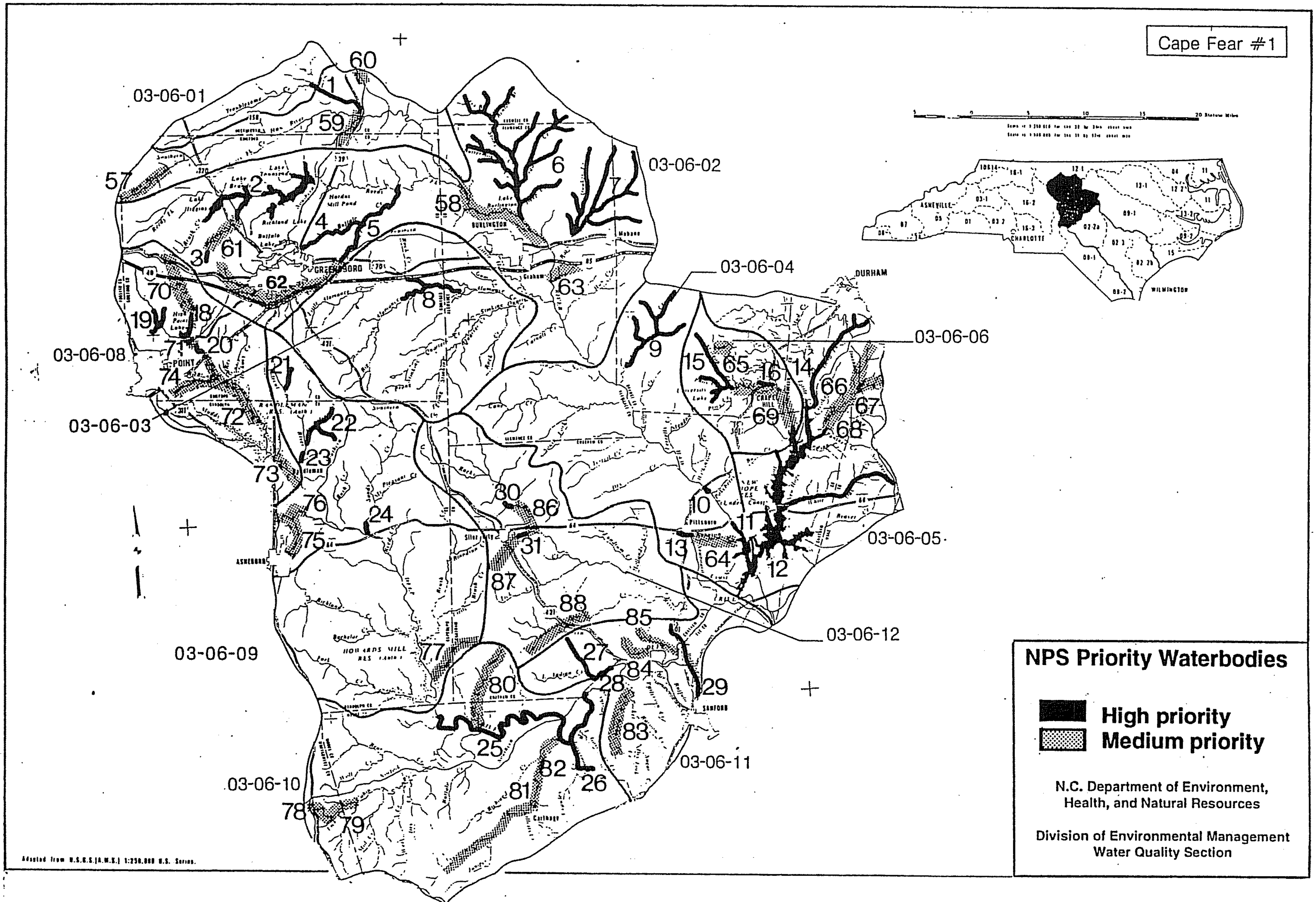

Figure 6.1a Map of Targeted Water Bodies for Nonpoint Source Management in the Haw and Deep River Watersheds

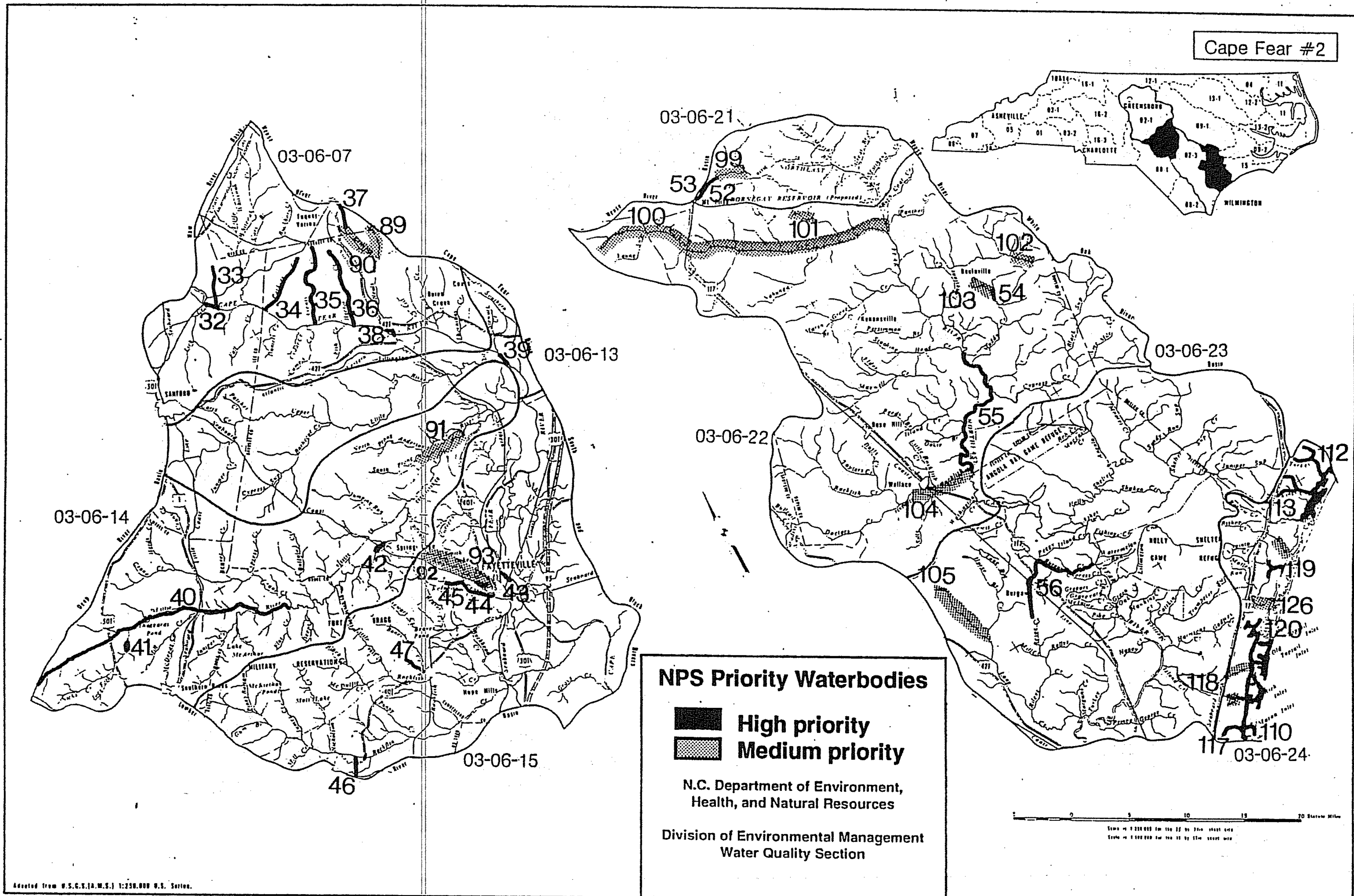

Figure 6.1b Map of Targeted Water Bodies for Nonpoint Source Management in the Upper Cape Fear and Northeast Cape Fear Watersheds

6.2.2 Identification and Protection of Highly Valued Resource Waters

Waters considered to be biologically sensitive or of high resource value may be afforded protection through 1) reclassification to HQW (high quality waters), ORW (outstanding resource waters) or WS (water supply), 2) through more stringent NPDES permit conditions or 3) through implementation of localized watershed protection efforts sponsored by local, state, federal or private interests.

Reclassification

Waters eligible for reclassification to HQW or ORW (see Appendix I) may include those approved for commercial shellfish harvesting (SA), designated primary nursery areas, designated critical habitat for threatened or endangered species (as designated by the NC Wildlife Resources Commission), waters having excellent water quality or those used for domestic water supply purposes (WS I and II). The HQW, ORW and WS classifications generally require more stringent point and nonpoint source pollution controls than do basic water quality classifications such as C or SC (Appendix I). Designated HQWs/ORWs in the Cape Fear basin are presented in Chapter 2.

Possible ORW/HQW candidates in the Cape Fear basin identified in the draft plan, based on water quality assessments presented in Chapter 4, included the following:

03-06-05: Morgan Creek upstream from NC 54 (above University Lake)
03-06-13: Cape Fear River at Erwin

DWQ has since reviewed the water quality data for these streams and determined not to pursue reclassification of Morgan Creek. Also, additional sampling on the Cape Fear River at Erwin will be needed to verify whether this stream segment has excellent water quality.

In addition to the streams listed above, the Environmental Management Commission (EMC) in 1990 considered reclassifying the lower Cape Fear River as High Quality Waters (HQW), as part of an initiative to implement the HQW supplemental classification adopted in 1989. The EMC expressed interest in having an alternative strategy developed for the lower Cape Fear River and remanded the reclassification request to the Hearing Officer for further consideration.

A Lower Cape Fear River Study Committee was subsequently established which was comprised of representatives of industry, academia, environmental interests and others. The Committee compiled all available data and information pertaining to the reclassification under consideration and endorsed an alternative management strategy. A Cape Fear River Program was also founded at the Center for Marine Science Research at UNC-Wilmington. The mission of the Cape Fear River Program is to develop an understanding of the processes which control and influence the river and to provide a mechanism for information exchange and public education. At their July 1993 meeting, the EMC voted to delay consideration of the alternative strategy and reclassification of the lower Cape Fear to HQW until after completion of the Cape Fear Basinwide Water Quality Management Plan. This would allow completion of the expanded monitoring that would take place as part of the basinwide process and through the Cape Fear River Program at UNC-W.

The Cape Fear River Program is currently seeking funding for conducting a basinwide, coordinated water quality monitoring program. In addition, the dischargers in the basin are in the process of developing a monitoring plan which will pool their resources and allow for a more comprehensive data coverage.

Consideration of any reclassification of the lower Cape Fear River will require additional information. This will allow the Section to evaluate and incorporate data and information that is produced as part of the Cape Fear River Program at UNC-W and the coordinated discharger monitoring program and to then develop a management strategy that reflects the unique nature of the system.

NPDES Permitting

Until reclassification is reconsidered, permit limits will be established to protect water quality standards through wasteload allocation standard operating procedures rather than the point source restrictions in the HQW management strategy rules (15A NCAC 2B .0201).

Where waters are known to support state or federally listed endangered or threatened species or species of concern, but where water quality is less than Excellent and where no critical habitat has been designated, consideration will be given during NPDES permitting to minimize impacts to these habitat areas consistent with the requirements of the federal Endangered Species Act and North Carolina's endangered species statutes. Possible protection measures, if determined to be warranted based upon the need to protect a particular species, may include dechlorination or alternative disinfection, tertiary or advanced tertiary treatment, outfall relocation, backup power provisions to minimize accidental plant spills, and others. The need for special provisions will be determined on a case-by-case basis during review of individual permit applications and take into account the degree of impact and the costs of protection.

NPS Targeting

As discussed in Section 6.2.1, above, there are over 100 stream segments identified in Tables 6.1, 6.2 and Figure 6.1 of known highly valued resources waters which are targeted for priority nonpoint source management efforts.

6.2.3 Managing Problem Pollutants in Order to Protect Unimpaired Waters

In addition to restoring impaired waters, protection of waters which currently meet their standards and are considered supporting their uses is a goal of the State's water quality program. The basinwide management approach facilitates this goal through more efficient use and analysis of monitoring data and through predictive computer modeling. Careful analysis of water quality data on a basin by basin approach allows improved identification of threatened waters. Where water quality appears to be degrading, a red flag can be raised. More concentrated monitoring efforts can be initiated and the information can be brought to the attention of local interests and other resources agencies. As noted in Section 4.5, almost half of the freshwater streams in the Cape Fear Basin that are rated as supporting their uses are considered threatened.

In addition to monitoring, basinwide management provides a framework for predicting water quality impairment through computer modeling, and then recommending measures that can be undertaken to avoid these impacts. This is most clearly seen through the Division's use of predictive computer modeling to determine the waste assimilative capacity of streams for various types of pollutants. Where capacities can be identified, then strategies can be developed to help ensure water quality standards can be protected. This type of approach is used extensively in Sections 6.3, 6.4 and 6.5 in addressing potential impacts of oxygen-demanding wastes (BOD), nutrients and toxicants from wastewater treatment plants on receiving water quality. Table 6.3 summarizes recommended strategies for a number of streams in the basin.

The management strategies outlined in the following sections are the results of comprehensive evaluations of previously summarized data, and they incorporate the effects of interaction between impacts of point and nonpoint sources. It is the intention of DWQ that the following recommendations serve the public of North Carolina for long-term planning purposes. The management strategies are comprised of two major components: recommendations for point and nonpoint source control. General nonpoint source management strategies are discussed thoroughly in Chapter 5. Point source controls are implemented through limiting wastewater parameters in NPDES permits.

6.3 RECOMMENDED MANAGEMENT STRATEGIES FOR OXYGEN-CONSUMING WASTES

Maintenance of dissolved oxygen is critical to the survival of aquatic life and to the general health of North Carolina's surface waters. While there are relatively few streams in the Cape Fear River basin that are experiencing significant impairment from low levels of dissolved oxygen, there are many miles of streams, including the mainstem of the river, in which DO levels are precariously low and where models predict that dissolved oxygen standards may be violated by new or expanding wastewater treatment plants.

The daily average dissolved oxygen standard for most waters in the state, and in the Cape Fear basin, is 5.0 mg/l. Waters classified as swamp waters may have naturally lower dissolved oxygen. The appropriate level of dissolved oxygen for swamp waters will vary from stream to stream. Biochemical oxygen demand (BOD) and ammonia nitrogen (NH_3) associated with wastewater treatment plants are generally the types of oxygen-consuming wastes of greatest

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6.3.2 Discharges to Swamp Waters
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- 6.3.3.2 Cape Fear River from Lock & Dam 3 to Lock & Dam 1
- 6.3.3.3 Cape Fear River from Lock & Dam 1 to Wilmington
- 6.3.3.4 Effects of Lock and Dams 2 and 3 on Dissolved Oxygen

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6.3.6 Strategies for the Deep River Watershed (Subbasins 08 to 12)
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6.3.10 Strategies for the Northeast Cape Fear River Watershed (Subbasins 21, 22 and 23)

concern. This is because the lowest concentrations of dissolved oxygen usually occur during summertime conditions when temperature is high and streamflow is low. During these periods point source discharges have their greatest impact, while nonpoint source pollution input, which results from rainfall events, is generally low. Therefore, NPDES permits for wastewater facilities generally limit BOD_5 (or $CBOD_5$) and NH_3 in point source discharge effluents to control the effects of oxygen depletion in receiving waters.

Modeling of the impacts of oxygen-consuming wastes from wastewater treatment plants on receiving waters is done to establish appropriate NPDES permit limits. Where the residual BOD from nonpoint sources is significant, management of nonpoint sources to reduce loading is recommended by implementation of best management practices. The choice of model, North Carolina's desktop empirical model or the field calibrated, QUAL2E model, is determined by the amount of data available for a given stream reach (Appendix III-A). The desktop empirical model is routinely used to determine wasteload allocations in the absence of intensive water quality studies of the discharge reach.

6.3.1. Discharges to Zero Flow Streams

The majority of the Haw River and Deep River drainage areas are located in the Carolina Slate Belt, which is characterized by low groundwater yield. Due to this geology, streams in this region have very low summer flows. According to the most recent U.S. Geological Survey (USGS) flow calculation methods, a minimum drainage area of 3 square miles is required to sustain a positive flow during a 7 day, 10 year low flow event (7Q10), and a minimum drainage area of 1 square mile is required to sustain positive flow during a 30 day, 2 year low flow event (30Q2). All but the largest tributaries in this area have 7Q10 flows under 0.1 cfs and limited assimilative capacity.

The Haw and the Deep Rivers flow together at Moncure to form the headwaters of the Cape Fear River in the Triassic Basin, and streams in the immediate area of this confluence are characterized by extremely low groundwater yields during drought periods. According to the most recent U.S. Geological Survey (USGS) methods, a minimum drainage area of 45 square miles is required to sustain a positive flow during 7Q10 flow event, and a minimum drainage area of 13 square miles is required to sustain positive flow during 30Q2 flow events for these areas. Tributaries to the Cape Fear in this area, at the confluence of the Haw and the Deep, include the Lick Creek watershed, as well as the White Oak and Buckhorn Creek watersheds (which are flooded to form Harris Lake). Shaddox Creek and Gulf Creek are also in the Triassic Basin.

From Buckhorn Dam to the community of Slocomb, the Cape Fear River and most of its tributaries lie in an area of mixed soils where flow estimates must be determined by USGS on a case by case basis. The downstream portions of the Upper Little River are in this region of mixed soils. The upstream portions of the Upper Little River watershed are in a region of sandy soils in which USGS estimates that a minimum drainage area of 2.0 square miles is required to sustain positive flow for 7Q10 and 30Q2. To the north and east of the Cape Fear mainstem as it winds to the coast, most tributaries are located in this region of sandy soils.

The Rockfish Creek and Lower Little River watersheds are located in the Sand Hills region. Streams in the Sand Hills are characterized by high yields during all flow stages. In this region, it is possible for very small drainage areas (i.e. 1.0 square mile or less) to sustain positive flow during 7Q10 and 30Q2 events. Below Rockfish Creek, tributaries on the south side of the Cape Fear Mainstem lie in clay soils. These streams in the lower areas of the basin will often hold stagnant standing water, but will have little or no fresh water inflow. USGS estimates that stream sites with drainage areas of less than 35 square miles will have no fresh water input during a 7Q10 flow event and sites with drainage areas of less than 2.0 square mile will have no fresh water input during a 30Q2 flow event.

Tributaries to the Northeast Cape Fear River are dispersed in areas of sandy soils, as described above for the Upper Little River, and in areas of clay soils, also described above. The Black River/South River watershed lies completely in the sandy soils region.

Due to the preponderance of low flow streams across the state and particularly in the Cape Fear River Basin, the Division developed regulations for evaluating discharges to zero flow streams. In 1980 studies were performed on zero flow streams (7Q10 and 30Q2 = 0 cfs) to determine the effect of wastewater discharges. The data concluded that:

- steady-state models do not apply to zero flow streams, particularly those receiving waste from small discharges;
- the pool/riffle configuration of these small streams results in DO standard violations even when the waste water is well treated;
- small streams receiving wastes from schools, mobile home parks, subdivisions, etc. flow through populated areas where children have easy access to the streams;
- noxious conditions were found in the low flow streams that were part of the study.

As a result of the study, regulations were developed that prohibit new or expanded discharges to zero flow streams. Existing facilities to zero flow streams were evaluated for alternatives to discharge. Many facilities found alternatives to a surface water discharge and some facilities built new treatment plants to meet advanced tertiary limits for BOD_5 and NH_3-N. Facilities that currently discharge to a zero flow stream but which have not yet been evaluated will receive the following language in their NPDES permit:

Removal of the discharge will be required if a more environmentally sound and economically achievable alternative is available. An engineering report evaluating alternatives to discharge is due 180 days prior to permit expiration along with the permit renewal application. As part of the report, the cost of constructing a treatment facility to meet limits of 5 mg/l BOD_5, 2 mg/l NH_3-N, 6 mg/l dissolved oxygen and 17 ug/l chlorine must also be included if there are no alternatives to a surface water discharge. Upon review of the results of the engineering report, the Division may reopen and modify this NPDES permit to require removal of the discharge, modified treatment designs, and/or revised effluent limitations within a specified time schedule.

This policy typically covers small discharges, i.e., schools, mobile home parks, rest homes, subdivisions, etc. which discharge to zero flow streams in headwater areas. While these discharges may not cause severe water quality problems in mainstem reaches of the Cape Fear Basin they can cause localized problems in their low flow receiving streams.

6.3.2. Discharges to Swamp Waters

Many of the streams in the Cape Fear River Basin are classified as swamp waters. DWQ does not have a good tool to evaluate the ability of these waters to assimilate oxygen-consuming wastes as our desktop dissolved oxygen model assumes a steady-state, one-dimensional flow, and these conditions may not exist in swamp waters. In addition, data analyses from a previously studied system in the Lumber River Basin indicated that critical conditions in a swamp system are not necessarily during low flow conditions. Inadequate flow and water quality data prevent verification of the relationship between flow and dissolved oxygen in many of the tributaries classified as swamp waters.

Given the difficulty of determining assimilative capacity in these waters, DWQ has identified the need to develop a better tool to evaluate a swamp system's ability to assimilate waste flow. A work group has been formed within the Water Quality Section to develop a methodology for determining which swamp systems can be modeled, to develop a desktop model for these systems, and to develop standard procedures for evaluating the assimilative capacity of those systems which cannot be modeled. Additionally, since many swamp systems naturally have low dissolved oxygen concentrations, the criteria by which impact is determined will be reevaluated. For example, changing the hydrologic regime of a swamp system by adding a large volume of wastewater may affect the surrounding ecosystem more than actual wastewater treatment. DWQ will also be investigating the potential for innovative outfall designs which allow a slower release of effluent to the system.

Until these studies are completed, new discharges will not be permitted at limits greater than 15 mg/l BOD_5 and 4 mg/l NH_3-N (NH_3-N may be lower if dilution is lower). On occasion, more stringent limits may be given if data or conditions suggest that adverse impacts will occur. Existing facilities will receive current permit limits unless they expand or site specific information is available which indicates more stringent limits are needed. Upon expansion, they will receive existing loading (mass basis). The following subbasin summaries describe other management strategies that may pertain to a given stream.

6.3.3. Mainstem Models

The Cape Fear River begins at the headwaters of the Haw and Deep Rivers. These rivers meet below the Jordan Dam on the Haw River to form the Cape Fear River. Flow in the Cape Fear River is regulated by the operation of Jordan Dam by the U.S. Army Corps of Engineers for flood control and maintenance of instream flows below the dam. Release from Jordan Dam is targeted so that the total flow downstream at Lillington (total flow from Deep River and Haw River/Jordan Dam outflow) is at least 550 cfs. USGS flow records for Lock & Dam 3 since construction of Jordan Dam in 1981, indicates an average daily flow of 2766 cfs and a minimum 7-day average flow of 806 cfs. The 7Q10 is seven day average low flow with a statistical recurrence interval of ten years, and is frequently approached in the Cape Fear due to regulation. USGS estimates of 7Q10 yields within the Cape Fear Basin downstream of the 550 cfs target at Lillington provide a 7Q10 flow estimate at Lock & Dam 3 of 791 cfs. It should be noted, however, that the natural 7Q10 (without the effect of Jordan Dam) is several hundred cfs less than the lowest observed flow in the last ten years.

Field calibrated models have been developed for much of the mainstem areas and are listed in the table below. The modeled areas are identified in Figure 6.3.

Table 6.4. Mainstem Models

Year	Waterbody	Modeled area
1995	Cape Fear River	Buckhorn Dam to Lock & Dam 3
1995	Cape Fear River	Lock & Dam 3 to Lock & Dam 1
1989	Cape Fear River	Federal Paper to Wilmington

These models will be used to determine wasteload allocations for the appropriate model reaches. In free-flowing areas which have not been modeled using the QUAL2E, the empirical desktop model, Level B, will be used to develop wasteload allocations per DWQ's modeling procedure. In tidal waters, management strategies will be developed on a case-by-case basis using all available flow and water quality information to assess discharge impacts.

6.3.3.1 Cape Fear River from Buckhorn Dam to Lock & Dam 3

A field calibrated model of the Cape Fear River beginning below Buckhorn Dam and extending to Lock & Dam 3 is under development. This modeled reach flows through subbasins 07, 13, 14, and 15 and includes nine of the facilities listed in Table 6.5. The current management strategy of BOD_5 = 12 mg/l and NH_3= 2 mg/l for new and expanding discharges below Buckhorn Dam appears to be protecting water quality: there have been no DO violations at the ambient monitoring stations within this modeled reach during the last five years. However, instream self-monitoring by the discharge facilities indicates DO violations occur under summer conditions. This instream facility self-monitoring is conducted on a weekly or 3 times per week basis while DWQ ambient monitoring is done monthly. Thus, self-monitoring may offer a more complete picture of the river conditions. A comparison between monthly ambient DO data collected by DWQ and self-monitoring DO data collected by dischargers on the mainstem of the river can be seen in Figures 4.17 and 4.18 in Chapter 4. In addition to low DOs, loading from this section of the Cape Fear is affecting water quality further downstream. Therefore, reductions in BOD loading will be examined through the modeling effort. In addition to these discharges, Angier has received a permit for discharge of 0.5 MGD with limits of BOD_5=12 and NH_3-N =2 and Monsanto is planning an expansion to 1.3 MGD.

Table 6.5. Discharges to Cape Fear River and tributaries from Buckhorn Dam to Lock & Dam 3

Facility	Subbasin	NPDES#	FLOW (MGD)	BOD5 (mg/l)	CBOD (lbs/day)	NH3-N (mg/l)	NBOD (lbs/day)
Fuquay-Varina WWTP	-07	NC0028118	1.2	16.0	256.2	5	225.2
Lillington WWTP	-07	NC0021636	0.6	12.0	162.1	2	45.0
Buies Creek WWTP	-07	NC0030091	0.5	30.0	550.4	20*	375.3
Swift Textiles	-13	NC0001406	2.5	40.8	8245	NL	NL
Erwin WWTP	-13	NC0064521	1.2	30.0	990.8	20*	900.7
Dunn WWTP	-13	NC0043176	3.0	30.0	1726.4	20*	2251.8
Fort Bragg WWTP	-14	NC0003964	8.0	16.0	2135	11	3302.6
Spring Lake WWTP	-14	NC0030970	1.5	28.0	770.6	8	450.4
Cross Creek WWTP	-15	NC0023957	22.0	8.0	3669.6	2	1651.3
Rockfish Creek WWTP	-15	NC0050105	12.0	6.0	3122.5	1	450.4
Raeford WWTP	-15	NC0026514	3.0	30.0	5179.1	20*	2251.8
Monsanto	-15	NC0003719	0.86	48.8	2905	3.2	103.5
total			**56.4**		**29457**		**11783**

** no limit; 20 mg/l is used for allocation purposes*

Using an estimated flow of 550 cfs at Buckhorn Dam, with long term BOD results from September 1994, BOD loading was estimated at the dam. BOD loads for this reach of the river appear to be dominated by the point sources. Point source CBOD loads are 1.5 times higher than the load calculated at Buckhorn. The total of the point sources and upstream load are only slightly greater than the load downstream at Lock & Dam 3. The mass balance of oxygen-consuming substances indicates little CBOD decay is occurring instream. It should be noted that through point and nonpoint source additions, the CBOD load has more than doubled from Buckhorn Dam to Lock & Dam 3.

Point source NBOD loads are 2.6 times higher than the load calculated at Buckhorn. The total of the point sources and upstream load are 80% lower than the load downstream at Lock & Dam 3. NBOD at Lock & Dam 3 is less than half the upstream NBOD load due to nitrogen decay. Based on the review of BOD loads, it appears that a significant fraction of oxygen loss is due to the oxidation of NH_3-N.

	CBOD (lbs/day)	NBOD (lbs/day)
Buckhorn Dam (1994)	19358	4536
Lock & Dam 3 (1994)	47243	2079

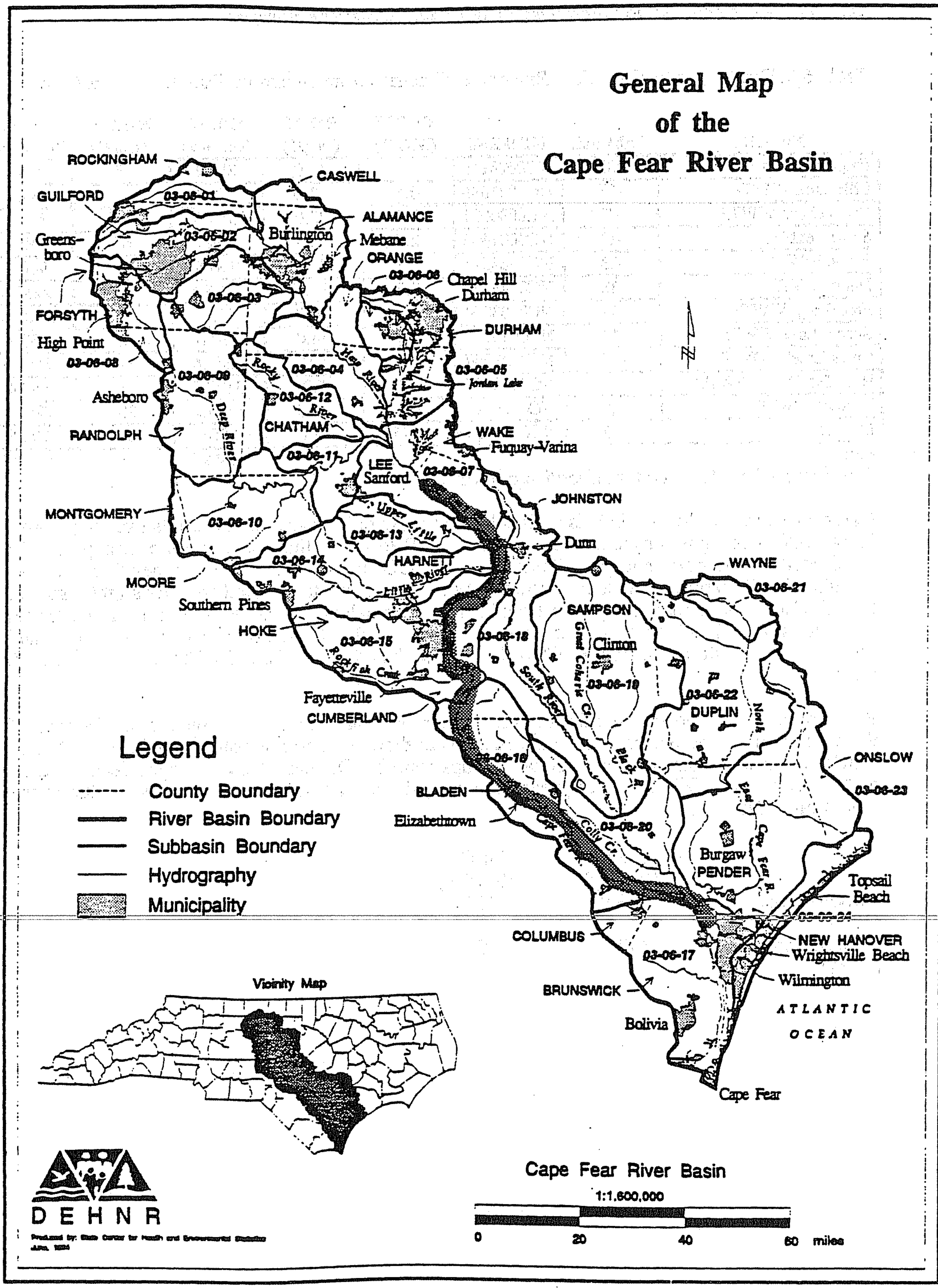

Figure 6.3 Field-Calibrated Models on the Mainstem of the Cape Fear River Buckhorn Dam to Wilmington

Preliminary modeling results indicate that the DO standard is not protected under current permitted loading. Modeling confirms the indication by instream data that the assimilative capacity of the river has been reached. At this time new and expanding discharges to the Cape Fear mainstem should prepare an alternatives analysis, including connection to a regional wastewater facility. If there are no other alternatives to discharge, treatment equivalent to that outlined in the table below will be recommended. A detailed description of the model development and management strategy will be available in a separate report upon completion.

	new	expanding
domestics < 1 MGD	BOD_5=12 & NH_3-N =2	BOD_5=12 & NH_3-N =2
domestics > 1 MGD	BOD_5=5 & NH_3-N =2	BOD_5=5 & NH_3-N =2
industrial	BOD_5=5 & NH_3-N =2	Best Available Technology or BOD_5=5 & NH_3-N =2

Technology-based limits will be determined on a case-by-case basis by DWQ, following a review of information submitted by the permittee.

6.3.3.2 Cape Fear River from Lock & Dam 3 to Lock & Dam 1

A QUAL2E model for the segment of the Cape Fear River between Locks & Dams 3 and 1 is currently under development. This area is contained within the subbasin 03-06-16 and includes 5 discharges of oxygen-consuming wastes (Table 6.6). Though there have been no DO violations at the ambient monitoring stations within this modeled reach during the last five years, instream monitoring by the facilities indicates DO violations occur under summer conditions. Due to the frequency of sampling, self-monitoring may offer a more complete picture of the river conditions. In addition to low DOs, loading from this section of the Cape Fear is affecting water quality further downstream. Therefore, reductions in BOD loading will be examined through the modeling effort.

Table 6.6 Discharges to the Cape Fear River between Lock & Dam 3 and Lock & Dam 1

FACILITY	NPDES#	FLOW (MGD)	BOD5 (mg/l)	CBOD (lbs/day)	NH3-N (mg/l)	NBOD (lbs/day)
Dupont-Fayetteville	NC0003573	2.0	10.5	1245.3	1.4	108
Carolina Foods	NC0078344	3.0	5.0	700.6	5	562.9
West Point Pepperell	NC0003522	2.5	10.9	1271.2	NL	NL
Elizabethtown WWTP	NC0026671	0.7	30.0	262.7	20*	525.4
East Arcadia School	NC0032913	0.006	30	2.25	20*	4.5
total				**3482**		**1201**

** no limit; 20 mg/l is used for allocation purposes*

In addition to these discharges, Elizabethtown has received a permit for discharge of 1.15 MGD with limits of BOD_5=12 and NH_3-N =2. Carolina Foods is planning an expansion to 4.5 MGD.

Long term BOD data from the 1992 time of travel survey was used with low flow estimates at Lock & Dam 3 (791 cfs) and above Lock & Dam 1 (843 cfs) to estimate BOD loads to the river reach. Point source CBOD loads are 10 times lower than the load calculated at Lock & Dam 3. The total of the point sources and upstream load are only slightly greater than the load downstream at Lock & Dam 1. The mass balance of oxygen consuming substances indicates little CBOD decay is occurring instream. It should be noted that through point and nonpoint source additions the CBOD load has only slightly increased between Lock & Dam 3 to Lock & Dam 1.

Point source NBOD loads are less than half the load calculated at Lock & Dam 3 The total of the point sources and upstream load is slightly lower than the load downstream at Lock & Dam 1. NBOD at Lock & Dam 1 is 1.5 times the upstream NBOD load due to nitrogen additions. Loads to the system appear to be outpacing nitrogen decay.

	CBOD (lbs/day)	NBOD (lbs/day)
Lock & Dam 3 (1992)	26,220	1,343
Lock & Dam 1 (1992)	30,125	2,045

This comparison of loads indicates that even without adding nonpoint sources of BOD, there is little CBOD or NBOD decay occurring within this reach of the river. One should note that the above data were collected before Carolina Foods began discharging. Carolina Foods has since doubled the ammonia load from wastewater.

Preliminary modeling results indicate that the DO standard is not protected under current permitted loading. Modeling confirms the indication by instream data that the assimilative capacity of the river has been reached. At this time new and expanding discharges should prepare an alternatives analysis including connection to a regional wastewater facility. If there are no other alternatives to discharge, treatment equivalent to that outlined in the table below will be recommended. A detailed description of the model development and management strategy will be available in a separate report upon completion.

	new	expanding
domestics < 1 MGD	BOD_5=12 & NH_3-N =2	BOD_5=12 & NH_3-N =2
domestics > 1 MGD	BOD_5=5 & NH_3-N =2	BOD_5=5 & NH_3-N =2
industrial	BOD_5=5 & NH_3-N =2	Best Available Technology or BOD_5=5 & NH_3-N =2

Technology based limits will be determined on a case-by-case basis by DWQ, following a review of information submitted by the permittee.

6.3.3.3 Cape Fear River from Lock & Dam 1 to Wilmington

The lower Cape Fear River below Lock and Dam 1 has occurrences of dissolved oxygen levels in the 3-4 mg/l range in the summer months. Minimum ambient dissolved oxygen concentrations for the last five years below Riegelwood decrease steadily from 5 mg/l near Acme to 3.6 mg/l near Phoenix to 3 mg/l at Navassa and then to 2.6 mg/l at Channel Marker #55. There are 12 permitted discharges in this reach of the Cape Fear River. The BOD loads for these discharges are summarized below in Table 6.7.

Table. 6.7 Discharger summary (permitted limits)

FACILITY	NPDES#	FLOW (MGD)	BOD5 (mg/l)	CBOD (lbs/day)	NH3-N (mg/l)	NBOD (lbs/day)
Federal Paper	NC0003298	50.0	12.0	29000	NL	NA
Wright Chemical (001)	NC0003395	0.0	5.0	10.4	2	1.5
Wright Chemical (002)	NC0003395	0.1	5.0	70.4	2	10.1
DuPont - Wilmington	NC0000663	NL		2775		1012.5
Takeda Chemical	NC0059234	1.0	57.3	2197.4	20	750.6
Fortron Industries	NC0082295	0.2	5.0	127.7	2	18.4
Cape Industries (001)	NC0001112	1.4	NL	NL	NL	NA
Cape Industries (002)	NC0001112	0.9	28.0	2743.9	NL	NA
Wilmington Northside	NC0023965	8.0	30.0	13211	20*	6004.8
Wilmington Southside	NC0023973	12.0	30.0	7506	20*	9007.2
New Hanover Landfill	NC0049743	0.1	30.0	156.4	NL	NA
Arcadian Corp.	NC0003727	0.3	NL	NL	24.9	261.9
Leland Industrial Pk.	NC0065676	0.3	30.0	781.9	NL	NA
New Hanover WWTP	NC0081763	4.0	5.0	2085	2	300.2
TOTAL LOAD		**78.3**		**60665**		**17367**

*no limit, 20 mg/l assumed in allocating wastes

The largest of these discharges are Federal Paperboard, Wilmington Northside, and Wilmington Southside. At permitted limits these discharges comprise 82% of the wastewater CBOD and 87% of the wastewater NBOD load to this reach of the river.

	% CBOD	% NBOD
Federal Paperboard	48	no limit
Wilmington North	22	35
Wilmington South	12	52
total	**82**	**87**

A QUAL2E model from Federal Paper's discharge to Wilmington was developed by Hydroscience, Inc. However, the model should be applied with caution since it is a one-dimensional, steady state model which has been applied to a multi-dimensional, tidal area.

Previous modeling analyses of the Cape Fear conducted in 1984 by the Division indicated the tidal range of the Cape Fear is 1 ft at Lock 1 and 3.6 ft at Wilmington. Tidal transport becomes increasingly important as the Cape Fear approaches the ocean. There is a salt wedge below Black River which carries low DO water under the freshwater from upstream sources. In addition to this source of low DOs, low DOs from Black River influences the mainstem. However, the steady state model GA.EST reinforced results of an earlier model, RECEIV-II, which showed the effect of Federal Paper's discharge on the Cape Fear DO levels. The model results indicate that DO improvements are expected if Federal removes additional BOD and adds oxygen, and if improvements are made in upstream water quality, i.e., the permit should reduce Federal to 3500 lbs/day of BOD_5 using a flow of 740 cfs at Lock 1.

The most recent modeling by Hydroscience indicated that dissolved oxygen falls below 5 mg/l without Federal Paper's discharge. The discharge of 4,000 lbs/day of BOD_5 creates an additional 0.8 mg/l dissolved oxygen deficit which can be mitigated somewhat by oxygen addition. The DO deficit can be reduced to 0.6 mg/l with the addition of 10,000 lbs/day of oxygen.

The most recent permit requires Federal to discharge less than 5000 lbs/day of BOD_5 between June and October and allows up to 10,000 lbs/day during the remaining months. Limits were based on Best Available Treatment for paper plants. However, Federal is currently operating under a variance which permits the months of April and May to be considered "winter" months during which higher quantities of BOD_5 may be discharged. Federal is also operating under an Special Order by Consent which allows relaxed limits for BOD_5 until 12/31/95. Federal operates a sidestream aeration system which feeds 10,000 lbs/day of oxygen to the Cape Fear River just below the Federal Paper outfall. The system operates whenever the instream DO concentration downstream near DuPont measures below 5 mg/l, and remains in operation until the downstream DO increases above 5 mg/l. Since 1985, the system has operated an average of 89 days (23 - 138 days) per season (June - October). During drought seasons, the system may operate every day, while during wet years, the oxygenation is needed only a few days per month.

As a result of documented water quality problems in this reach of the river, all new and expanding discharges will be required to conduct an engineering alternatives and economic analysis including the feasibility of connecting to municipal sewer service. If there are no feasible alternatives, a detailed evaluation of the potential impact of the discharge will be required and NPDES limits equivalent to those outlined in the table below will be recommended for discharges to the Cape Fear River.

	new	expanding
domestics < 1 MGD	BOD_5=12 & NH_3-N =2	BOD_5=12 & NH_3-N =2
domestics > 1 MGD	BOD_5=5 & NH_3-N =2	BOD_5=5 & NH_3-N =2
industrial	BOD_5=5 & NH_3-N =2	Best Available Technology or BOD_5=5 & NH_3-N =2

Technology based limits will be determined on a case-by-case basis by DWQ, following a review of information submitted by the permittee.

6.3.3.4 Effects of Lock and Dams Nos. Two and Three on Instream Dissolved Oxygen

In preparation for the Cape Fear Basinwide Management Plan, DWQ developed a series of field calibrated QUAL2E water quality models to examine the effects of cumulative loading of oxygen demanding wastes on the Cape Fear River mainstem from Buckhorn Dam to Army Corps' Lock and Dam #1. The modeling analysis indicated that the river mainstem was significantly affected by cumulative loading of oxygen demanding wastes from point source discharges. The dissolved oxygen profile resulting from the model shows that, when all sources discharge at maximum permitted loads with the river at low flow conditions, DO levels immediately below the dams will be in an acceptable range of 6-7 mg/l, but as it progresses downstream and the velocities of the river slow approaching each lock and dam structure, the DO will gradually decline and sag below 5.0 mg/l for a considerable stretch prior to each dam. As the cumulative loading increases moving downstream the sag behind each lock & dam becomes slightly more severe, with the sag behind Lock & Dam #1 being the most pronounced with a DO minimum of 4.3 mg/l. A copy of the DO profile from Lock and Dam #3 to Lock an Dam #1 is attached.

Instream DO levels in the river are determined by the balance between the rate at which oxygen consuming wastes are broken down instream (referred to as the decay rate) and the rate at which reaeration of the river occurs at its surface. The reaeration rate, the rate at which oxygen is mixed into the river, is a function of river velocity, width and depth. As the river approaches a dam, the velocity slows and less oxygen is mixed into the water, which allows the decay of oxygen consuming wastes to lower DO levels significantly. The effects of the lock and dam structures on water quality are localized but they are caused by the large cumulative load of oxygen consuming wastes discharged upstream. Removing a lock and dam may alleviate the local effects, but would likely shift them downstream, where the pollutant load would potentially exert itself at a greater magnitude, causing even lower DO levels at the next dam.

The U.S. Army Corps of Engineers has just recently spent about $1,000,000 refurbishing the lock and dam facilities for all three structures, and in recent meetings with DWQ, has expressed a reluctance to consider their removal due to ongoing navigational needs in the river. Even if the removal of Lock and Dams #3 and #2 could ultimately be affected, the removal would likely push the impact of the large pollutant load downstream to Lock and Dam #1, which cannot be removed because it protects the City of Wilmington's water supply intake from salt water intrusion from the estuarine portion of the Cape Fear.

6.3.4. Additional Field Calibrated Models

Field calibrated QUAL2E models have been developed or are under development for the streams listed below (Table 6.8). The models are summarized in the respective subbasin discussions. The modeled areas are identified in Figure 6.4.

Table 6.8 Field Calibrated Models

Year	Waterbody	Modeled area	subbasin
1995	Buffalo Creek/ Reedy Fork	North Buffalo Creek & South Buffalo Creek to Reedy Fork at Ossipee	03-06-02
1995	Haw River	Reedy Fork to Saxapahaw	03-06-02
1991	Rocky River	Loves Creek to Rocky River	03-06-07
1991	Morgan Creek	OWASA to Jordan Reservoir	03-06-06
1989	New Hope Creek	Durham - Farrington Rd WWTP to Jordan Reservoir	03-06-05

6.3.5 Recommended Control Strategies for Oxygen-Consuming Wastes in the Haw River/Jordan Lake Watershed (Subbasins 01 through 06)

Subbasin 01 - Haw River Headwaters This subbasin, the headwaters of the Haw River, generally offers little assimilative capacity for oxygen-consuming wastes due to low stream flows and high sediment oxygen demand. The Haw River and its tributaries upstream of SR 2711 near the Rockingham-Guilford County line are typically slow-flowing and swampy. Although there is only one major discharge to the Haw River in this subbasin, DO values at the State standard of 5 mg/l have been recorded. The desktop model will be applied as applicable. To protect the stream standard and allow for the allocation of the limited assimilative capacity in the subbasin, limits no less stringent than 15 mg/l of BOD5 and 4 mg/l of NH_3-N are recommended for new and expanding discharges to the Haw River and its tributaries upstream of SR 2711.

Currently only one major facility, Glen Raven Mills, discharges directly to the Haw River in this subbasin. However, Reidsville may relocate its discharge from Little Troublesome Creek to the Haw River to benefit from increased dilution and better assimilation of the wastewater. At the existing discharge location, the instream waste concentration downstream of the Reidsville WWTP is 98%. Reidsville currently discharges 5 MGD at limits of 6 mg/l BOD5 and 2 mg/l NH_3-N. With the relocation of the Reidsville WWTP, improvements to water quality are expected in Little Troublesome Creek which has been over allocated for oxygen-consuming wastes. Reidsville has received limits for expansion to 7.5 MGD at the current location of 5 mg/l BOD5 and 2 mg/l NH_3-N. If Reidsville pursues relocation to the Haw River, the same limits will apply.

Subbasin 02 (North and South Buffalo Creeks and Haw River in Alamance County) This subbasin contains a number of major facilities, industrial and municipal, and several areas where water quality is impaired as a result of over allocation, facility non-compliance, excessive non-point runoff, and other factors. Modeling analyses suggest that point sources are causing BOD/DO and toxicity problems, and contributing largely to nutrient related problems.

Recommended allocations reflect the level of treatment necessary to reduce the magnitude and frequency of water quality standard violations.

Buffalo Creek/Reedy Fork

North and South Buffalo Creeks, from their headwaters to their confluence at Buffalo Creek/Reedy Fork are low flow streams, dominated by the City of Greensboro's WWTPs and Cone Mills' effluents. Both streams also receive both urban and agricultural runoff. These creeks as well as Buffalo Creek and Reedy Fork are on the state's impaired waters list.

Ambient and self-monitoring water quality data, along with the results of QUAL2E modeling, indicate that Buffalo Creek is a marginal system with respect to assimilative capacity which has been over allocated for oxygen-consuming wastes. DWQ and facility self-monitoring data show severely low DO concentrations (less than 2 mg/l) in North and South Buffalo Creek below the WWTPs during summer conditions. Though the Greensboro treatment plants were in compliance with their permits, numerous violations of the DO standard were observed below Cone Mills and Greensboro's North Buffalo WWTP during the summers of 1993 and 1994. Cone Mills did not report BOD5 levels for much of the summer of 1993. During that period, instream DO levels below Cone Mills' discharge were severely degraded. This is reflected in the self-monitoring data of both Cone Mills and Greensboro's North Buffalo WWTP. These creeks also have poor biological quality. A QUAL2E model has been developed from Cone Mills on North Buffalo Creek and from the T.Z. Osborne WWTP on South Buffalo Creek to Reedy Fork at Ossipee in order to reallocate NPDES permit limits for the protection of water quality (Figure 6.4).

Table 6.9 Existing summer limits for major discharges

FACILITY	NPDES No.	Permitted flow (MGD)	Average flow (MGD)	BOD5 (mg/l)	NH3-N (mg/l)	DO (mg/l)
Cone Mills	NC0000876	1.25	1.145	10	2	6
North Buffalo WWTP	NC0024325	16	14.75	10	4	6
T.Z. Osborne WWTP	NC0047384	20	16.7	11	3	5

With the existing discharges at their average loads, the model predicts a DO sag to 4.0 mg/l on South Buffalo Creek just downstream of the T.Z. Osborne WWTP and sags to 4.9 mg/l on North Buffalo Creek below Cone Mills and to 4.7 mg/l below the North Buffalo WWTP. Buffalo Creek just downstream of North and South Buffalo Creeks has a DO concentration of 4.6 mg/l. Though the T.Z. Osborne and North Buffalo Wastewater Treatment Plants (WWTPs) operate within their permit limits, observed DOs below the WWTPs for April through October 1993 and 1994 violate the state standard for DO. The observed instream DOs confirm the model predictions.

If the three existing major discharges reach their permitted loads, the model predicts that instream DO concentrations will sag to 0.8 mg/l on South Buffalo Creek and to 3.4 mg/l on North Buffalo Creek. Buffalo Creek below the confluence will sag to 2.3 mg/l. The model indicates that it will be difficult under any management strategy for South Buffalo Creek to meet the 5.0 mg/l stream standard for dissolved oxygen under critical conditions because of existing physical conditions (e.g., low streamflow and slow velocities) and the large amounts of wasteflow relative to streamflow. The model was run assuming Cone Mills and the Greensboro WWTPs will implement "Best Available Technology" (BAT) to achieve tertiary treatment (i.e., BOD_5 = 5 mg/l, NH_3-N = 1 mg/l, and DO = 6-7 mg/l). With these effluent limits, the model predicts the DO

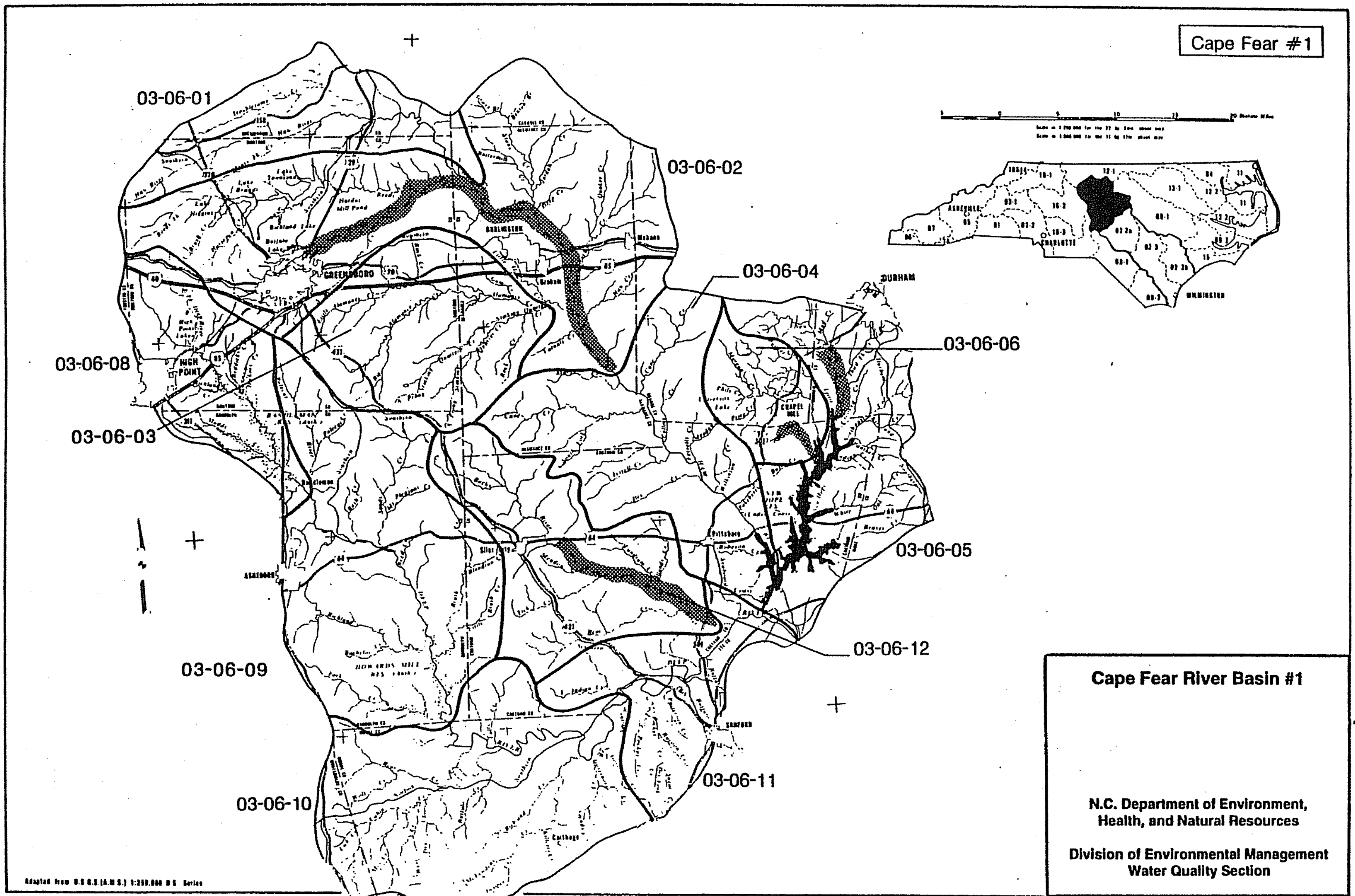

Figure 6.4 Calibrated Models for Streams in the Haw and Deep River Watersheds

concentrations will sag to 3.5 mg/l below T.Z. Osborne WWTP and to 5.1 mg/l below the North Buffalo WWTP. Below the confluence DO is still predicted to violate the DO standard. A detailed description of the model development can be found in a separate report (NC DEM, 1995).

In light of the extremely limited assimilative capacity for oxygen-consuming wastes in Buffalo Creek, no new wastewater outfalls should be constructed within the modeled area. The existing municipal facilities, should serve as regional treatment facilities to handle future wastewater needs. All remaining permitted facilities should conduct an engineering alternatives and economic analysis including the feasibility of connecting to municipal sewer service. If there are no feasible alternatives, limits of BOD_5=5 mg/l, NH_3-N=2 mg/l, and DO=6 mg/l will be recommended and a schedule for implementation developed. It is anticipated that, through basinwide planning, all discharges within the Buffalo Creek Basin will eventually be required to implement state-of-the-art treatment technology. At this time, the technology limits are BOD_5=5 mg/l, NH_3-N=2mg/l, and DO=6 mg/l. Future wastewater expansions may require environmental assessments.

New and expanding discharges to tributaries within the modeled area should have no adverse impact on the mainstem water quality. The desktop model should be run and wastewater fully assimilated prior to confluence with the mainstem area.

Haw River

This section of the Haw River, from the confluence of Reedy Fork Creek and the Haw River to Saxapahaw dam, is dominated by wastewater effluent during low summer flows. This is confirmed by high instream conductivity recorded at the ambient station near the town of Haw River. In addition to major facilities in the Reedy Fork Creek drainage area, East Burlington WWTP (12 MGD) and Graham WWTP (3.5 MGD) discharge to the Haw River. South Burlington WWTP (12 MGD) discharges to Alamance Creek just before it joins the Haw River. Considering all major discharges upstream of Saxapahaw, this results in a total waste flow of 74.75 MGD, or a 59% instream waste concentration at 7Q10 flow conditions. While the average daily dissolved oxygen standard of 5 mg/l is currently protected in this section of the Haw River, the predominance of wastewater effluent under summer conditions and projected growth in the area prompted the development of a field-calibrated QUAL2E model. The model starts near Altamahaw, at the confluence of Reedy Fork Creek and the Haw River, and ends just below the Saxapahaw Dam. The model is currently being developed, though there are insufficient data for full field calibration at this time. As future expansions of existing regional wastewater treatment plants place additional demands on the Haw River, this model will be fully developed to evaluate the assimilative capacity of oxygen consuming wastes.

Moadams Creek/Back Creek

The Mebane WWTP discharges 1.2 MGD of municipal wastewater to Moadams Creek, a zero 7Q10 tributary of Back Creek at limits of 11 mg/l BOD_5 and 4 mg/l NH_3-N. The instream waste concentration of Back Creek prior to the confluence with the Haw River is approximately 80%. During the July 1993 time of travel study for Haw River, the instream DO level at the mouth of Back Creek was 4.3 mg/l. Mebane's self-monitoring data show DO levels as low as 0.7 mg/l in Moadams Creek below the Mebane WWTP discharge. DO levels in Back Creek at SR 1936 were as low as 3 mg/l during 1993 while further downstream at NC 54, the lowest observed DO in 1993 was 4.4 mg/l. A benthic survey is recommended to evaluate the impact of the Mebane WWTP discharge and determine the stream's recovery. On average, the facility operates well within its limits, however there have been violations of the daily maximum permit requirements. Upon expansion to 2.5 MGD, Mebane will be required to meet limits of 5 mg/l BOD_5 and 2 mg/l NH_3-N in accordance with 15A NCAC 2B.0206.

In light of the extremely limited assimilative capacity for oxygen-consuming wastes in Back Creek and its tributaries, no new wastewater outfalls should be constructed. The existing municipal facility, should serve as the regional treatment facility to handle future wastewater needs. New and expanding facilities should be required to conduct an engineering alternatives and economic analysis including the feasibility of connecting to municipal sewer service. If there are no feasible alternatives, limits of BOD_5=5 mg/l, NH_3-N=2 mg/l, and DO=6 mg/l will be recommended and a schedule for implementation developed.

Haw Creek

During the June 1994 TOT study for the Haw River, the instream DO level at the mouth of Haw Creek was 4.8 mg/l. The source of low DO is unknown, though a number of single family residences discharge to Haw Creek. An investigation of sources including nonpoint sources is recommended. In 1993, Haw Creek received a biological rating of good-fair.

Subbasin 03 (Alamance Creek) This subbasin is comprised of Alamance Creek watershed which originates south of Greensboro and feeds into the Haw River immediately below Burlington. Major tributaries include Big and Little Alamance Creeks and Stinking Quarter Creek. The only major discharge in the creek's basin is the Burlington - South WWTP which is permitted to discharge up to 12.0 MGD to Big Alamance Creek immediately prior to the confluence with the Haw River.

The upper portion of the watershed has several small discharges including schools and mobile home parks along with a few single residence discharges. There are 9 small treatment plants and 2 residential discharges with a total combined wasteflow of 150,400 gpd. The cumulative instream waste concentration prior to the Burlington - South's outfall is 7.2%. The localized impacts of these discharges are significant because most of the outfalls are located in zero flow streams. Ambient DO has been observed at 4 mg/l in Alamance Creek and at 5 mg/l in Little Alamance Creek. Alamance Creek received a water quality rating of good-fair in 1993 while Little Alamance Creek received a good rating.

Water quality in this watershed would benefit from more extensive regional wastewater treatment. These facilities should explore and implement alternatives to surface water discharge and/or tie into larger treatment facilities within a reasonable period of time after such service becomes available. Most of the discharges are relatively near Greensboro's T.Z. Osborne WWTP or Burlington - South WWTP, which should function as the regional wastewater treatment facilities for this area.

Subbasin 04 (Lower Haw River and Tributaries) This subbasin includes the Haw River and its tributaries from Saxapahaw Dam to Jordan Reservoir. With the exception of the Haw River mainstem, most streams are low flow. Standard policies and regulations for zero flow discharges will apply.

Haw River

The QUAL2E model under development for the Haw River to Saxapahaw, will be extended to Jordan Reservoir for the next basin plan. No DO violations have been observed in this reach during the last five years.

Robeson Creek

The Pittsboro WWTP discharges 0.75 MGD to Robeson Creek, a zero 7Q10 tributary of Jordan Reservoir with fair water quality (1990 BMAN sampling). Pittsboro's self-monitoring data show DO levels as low as 3.7 mg/l in Robeson Creek below the Pittsboro WWTP discharge and however, concentrations are lower upstream. Though the ambient DOs appear to have improved since 1988, ambient DO downstream of Pittsboro has been observed at 3 mg/l during the last 5 years. Comparison of ambient data to facility instream monitoring is difficult since the ambient station is located in an arm of Jordan Reservoir and may not be representative of stream conditions. The Town of Pittsboro recently completed an upgrade to 5 mg/l BOD_5 and 1 mg/l NH_3-N. However, there have been violations of the BOD_5 limit, particularly the daily maximum limit. A reconnaissance study should be undertaken to determine the source of impacts upstream of Pittsboro's discharge and to evaluate any improvements resulting from Pittsboro's upgrade. A follow up benthic survey is recommended for the next basin assessment.

Subbasin 05 (Jordan Reservoir Watershed except Haw River and Morgan Creek)
New Hope Creek, Northeast Creek, and other smaller tributaries to Jordan Reservoir comprise this subbasin. This is the entire Jordan Reservoir drainage with the exception of the Haw River and Morgan Creek. There are two major municipal WWTPs in this subbasin, Durham-Farrington Road and Durham-Triangle, each of which has recently expanded and/or upgraded to tertiary limits for both oxygen-consuming wastes and nutrients. Extensive data from Jordan Reservoir reveal water quality problems caused by the sensitive nature of lake headwaters to receiving wastewater. Water quality problems include DO and eutrophication problems, and during the summer months much of the input to upper Jordan Reservoir from this subbasin is effluent.

A field calibrated model was done for New Hope Creek in 1989. The QUAL2E model extends 5 miles from the Durham-Farrington Road WWTP to Jordan Reservoir. The WWTP comprises 99% of the streamflow under summer low flow conditions. The model predicted the existing permit limits do not protect water quality. In addition, upon expansion from 10 MGD to 20 MGD advanced tertiary treatment to 5 mg/l BOD_5 and 1 mg/l NH_3-N was recommended to protect the DO standard (NC DEM, 1989). A detailed description of the model development can be found in a separate report. Currently the facility is under an SOC allowing relaxed limits for BOD_5, NH_3, and DO. Ambient instream DOs have been observed at 4.4 mg/l. Durham's self-monitoring data shows DO levels as low as 2.5 mg/l in New Hope Creek below the Farrington Road WWTP discharge.

A proliferation of single family residence and other small discharges has occurred in the upper portion of the New Hope Creek watershed. Upstream of the Durham/Farrington Road WWTP there are at least 15 single family residences discharging, as well as one subdivision, a rest home and two mobile home parks. In addition, there is a potential for additional unpermitted discharges of this nature in the watershed. The localized impacts of these discharges are increased because most of the outfalls are located in zero flow streams. The cumulative instream waste concentration ~~(IWC) of these discharges is 67% prior to the Farrington Road WWTP discharge. DO levels~~ below these discharges are consistently low with DOs less than 1 mg/l having been observed during drought conditions.

Water quality in this watershed would benefit from more extensive regional wastewater treatment. The larger treatment facilities in this area, such as Durham/Farrington Road or Orange Water and Sewer Authority should make efforts to provide service to the upper areas of the watershed as soon as possible, and small discharges should be encouraged to connect to regional facilities as soon as service becomes available. Due to continued violations of the water quality standard, no new discharges will be permitted to New Hope Creek.

Durham County's Triangle WWTP discharges 6 MGD to the Northeast Creek arm of Jordan Reservoir and meets advanced tertiary treatment limits of 5 mg/l BOD_5 and 1 mg/l NH_3-N. Instream DOs at the ambient station have been observed at 4 mg/l while Durham's self-monitoring data show DO levels as low as 0.3 mg/l in Northeast Creek below the Triangle WWTP discharge. Water quality remains impaired as 99% of the streamflow is wastewater under summer low flow conditions. This creek receives no freshwater inflow and should receive no new discharges per 15A NCAC 2B.0206.

Subbasin 06 (Morgan Creek tributary to Jordan Reservoir) Subbasin 06 is a very small basin that is primarily the drainage area surrounding Chapel Hill. The major stream is Morgan Creek, which flows into Jordan Reservoir. Water quality in this watershed would benefit from more extensive regional wastewater treatment. The larger treatment facilities in this area, such as Durham/Farrington Road or Orange Water and Sewer Authority should make efforts to provide service to the upper areas of the watershed as soon as possible, and small discharges should be encouraged to connect to regional facilities as soon as service becomes available. New and expanding discharges should conduct an alternatives analysis including non-discharge alternatives and the feasibility of connecting to municipal sewer service.

A field calibrated model was done for Morgan Creek in 1991. The QUAL2E model extends 5 miles from the Orange Water and Sewer Authority (OWASA) Mason Farm WWTP to Jordan Reservoir. A detailed description of the model development can be found in a separate report (NC DEM, 1991). The WWTP comprises 95% of the streamflow under summer low flow conditions. The model predicted the existing permit limits do not protect water quality. However, the WWTP has been operated well below the permitted limits. Upon completion of the permitted expansion from 8 MGD to 10 MGD OWASA will be required to achieve advanced tertiary treatment levels of 4 mg/l $CBOD_5$ and 2 mg/l NH_3-N. This level of treatment was recommended to improve the instream DO level (NC DEM, 1991). The model predicts DOs may still fall below 5 mg/l under summer low flow conditions. Ambient DO levels less than 5.0 mg/l (4.8 mg/l) have been observed below the WWTP. OWASA's self-monitoring data shows DO levels as low as 4.6 mg/l in Morgan Creek below the discharge. DOs are expected to improve with the increased wasteflow, stream velocity and treatment plant removal efficiency when OWASA completes its expansion. Due to continued violations of the water quality standard, Morgan Creek should receive no new discharges.

6.3.6 Recommended BOD and NH_3 Strategies for the Deep River Watershed (Subbasins 08 through 12)

Overview

The Deep River is one of two headwater tributaries of the Cape Fear River. It begins west of Greensboro and flows southeast through Guilford, Randolph, and Moore counties to High Falls, where it turns and flows northeast along the Chatham and Lee county line until it meets the Haw River near Moncure (Figure 6.5). In the upper reaches the Deep River is shallow and rocky as it flows through the rolling hills of the Piedmont, while the lower, easternmost reaches are flatter, with greater depths and slower velocities. Seventeen dams create impoundments which slow flow and trap pollutants. Because the Deep River lies in the Carolina Slate Belt, 7Q10 flows are very low and all but the largest tributaries are zero-flow streams. DO violations have been observed at a number of ambient sites, with most violations occurring downstream of Carbonton Dam in the lower reaches of the Deep River.

The East Fork Deep River and the West Fork Deep River form the High Point Reservoir between High Point and Greensboro. This area receives runoff from urban, industrial, agricultural, and forested areas: there are few point source discharges. The river is also impounded downstream from High Point Lake at Oakdale, as well as by two small dams downstream of Richland Creek. Field data show a violation of the dissolved oxygen standard below High Point Lake dam, but the cause of this violation is currently unknown. The violation may be the result of low DO releases from High Point Lake, though further study is needed to identify the cause.

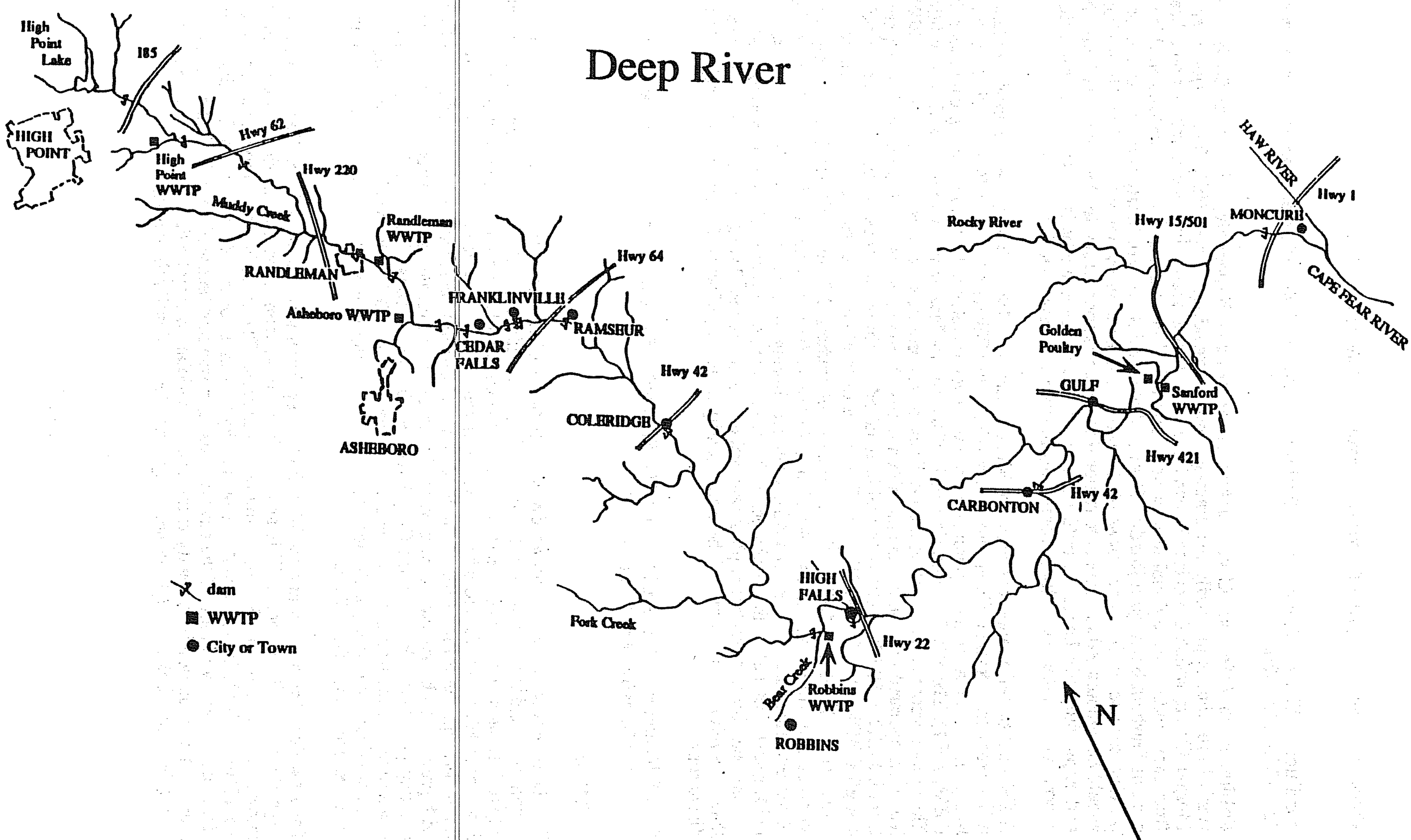

Figure 6.5 Map of Deep River Mainstem

The largest wastewater treatment facility within the Deep River basin, High Point - Eastside, discharges 16 MGD of treated wastewater to Richland Creek, a low flow tributary of the Deep River. During 7Q10 conditions this discharge makes up 90% of the flow in Richland Creek and 73% of the flow in the Deep River at Freeman Mill. Violations of the DO standard below Richland Creek were reported in facility instream self-monitoring data at SR 1129 and at the ambient site below Coltranes Mill, with an observed DO minimum of 1.2 mg/l in 1993. Facility data from Randleman WWTP show the DO recovers in downstream reaches near Randleman.

River flow in the reach downstream from High Point, from Randleman to Coleridge, is controlled by eight impoundments. The second largest facility in the basin, Asheboro WWTP, discharges 6.0 MGD to Hasketts Creek, with a permitted expansion to 9 MGD. Hasketts Creek joins the Deep River just upstream of Cox Lake, a large hydroelectric impoundment. Asheboro self-monitoring data from Cox Lake at SR 2261 show violations of the state minimum DO standard and of the DO saturation standard of 110%. The elevated DO saturation (as high as 174%) is indicative of algae blooms and overenrichment. This will be discussed in Section 6.4, Management Strategies for Nutrients.

The Deep River is classified as HQW between Robbins and Carbonton Dam. The Town of Robbins discharges within this HQW section just above a hydroelectric dam. Robbins requested a speculative analysis for an expansion of its treatment facility. The analysis was prepared in accordance with the HQW regulations.

Carbonton Lake, downstream of High Falls, is another large impacted hydroelectric impoundment on the Deep River. Violations of the DO and the chlorophyll *a* standards have been recorded by DWQ personnel behind Carbonton dam. DWQ studies of this impoundment show the DO sags are the result of excessive algae growth. Further discussion of algae-related DO problems is in Section 6.4 Management Strategies for Nutrients.

Below Carbonton Dam there are numerous DO violations and a secondary sag downstream at Sanford (3.8 mg/l in 1992). Sanford WWTP and Golden Poultry are the only major discharges in this subbasin. To better identify causes of DO violations within and below the Carbonton impoundment, a DWQ study was conducted in the summer of 1993. The study concentrated on the section of the Deep River from Ramseur to HWY 15/501. This reach of the Deep River exhibits high productivity with significant periphyte growth occurring throughout the free-flowing sections. Study results showed that long-term BOD levels were moderate but diurnal fluctuations in DO concentrations existed both upstream and downstream of the impoundment. This fluctuation is the result of excessive algae growth and indicates the recorded DO violations were caused by algae growth and die-off.

<u>Recommended Management Strategies (Subbasins 08 through 11)</u>

DWQ ambient monitoring and facility self-monitoring data indicate that dissolved oxygen levels fall below minimum criteria or are lowered to levels where further loss may be harmful to aquatic life. The cause of low dissolved oxygen levels below High Point Lake should be investigated. Consideration of options, including a minimum release requirement for High Point Lake, should be evaluated.

Due to the predominance of wastewater in this system during low flow conditions it is recommended that all new and expanding major facilities in the Deep River basin between High Point Reservoir and Carbonton dam be issued advanced tertiary limits (BOD_5 = 5 mg/l and NH_3-N = 2 mg/l). For new and expanding discharges between High Point Lake and Carbonton dam with flows less than 1 MGD, regionalization of wastewater treatment is encouraged. If discharge to a regional WWTP is not feasible, an alternatives analysis should be performed to evaluate all practicable alternatives to surface water discharge. Where discharge is the most feasible option, permit limits no less stringent than BOD_5 = 15 mg/l and NH_3-N = 4 mg/l are recommended. Additionally, because DO violations in the Deep River are strongly linked to algae growth, nutrient limits will be recommended in this section. This is discussed in Section 6.4 Management Strategies for Nutrients.

In the section of the Deep River from Carbonton dam to the Haw River, the assimilative capacity is exhausted and new discharges should not be permitted. Expansion requests by Sanford WWTP due to further regionalization will be thoroughly evaluated to insure no additional water quality degradation will result.

Richland Creek

Richland Creek (subbasin -08) is a small urban stream with a 7Q10 of 1.1 cfs. The City of High Point's Eastside WWTP discharges 16 MGD to Richland Creek just above the confluence with the Deep River. At permitted flows, the instream waste concentration in Richland Creek is 96%. The High Point Eastside discharge permit currently contains limits of BOD_5 = 8 mg/l and NH_3-N = 3 mg/l. A modeling analysis conducted in 1987 indicates the need for advanced tertiary limits of BOD_5 = 5 mg/l and NH_3-N = 2 mg/l. Due to the high IWC, the reported instream occurrences of dissolved oxygen below the 5.0 mg/l daily average standard, and water quality problems in downstream impoundments, it is recommended that High Point Eastside WWTP be issued limits of BOD_5 = 5 mg/l and NH_3-N = 2 mg/l. DWQ will work with the facility to determine an appropriate schedule for these changes.

Hasketts Creek

Hasketts Creek (subbasin -09) below the Asheboro WWTP has a zero 7Q10 and receives 6 MGD of municipal wastewater with advanced tertiary limits of BOD_5 = 5 mg/l and NH_3-N = 2 mg/l. The City is currently in the process of expanding the facility to 9 MGD with the same limits. Relocation to the Deep River was considered but assimilative capacity is limited in the Deep River as well as in Hasketts Creek. Thus, it is more economical for the City to remain on Hasketts Creek since there are currently no DO violations in Hasketts Creek below the WWTP. Water quality is rated poor below the WWTP due to effluent dominance. Conductivity is ten times higher downstream and temperature is significantly greater downstream.

Cotton Creek

The Town of Star WWTP (subbasin -10) is permitted to discharge 0.6 MGD of complex wastewater (90% industrial) to Cotton Creek, a zero 7Q10 and zero 30Q2 stream with limited assimilative capacity for oxygen consuming wastes. Currently, the facility has summer (winter) limits of 17 (26) mg/l BOD_5 and 4 (8) mg/l NH_3-N. Since the facility discharges to a zero flow stream, it is required to meet advanced tertiary limits of BOD_5 = 5 mg/l and NH_3-N = 1 mg/l in August 1995 per its current NPDES permit.

The current permit limits do not protect water quality. DOs have been low downstream of the discharge throughout the summer of 1994 including observed DOs less than 2 mg/l. The facility has been out of compliance with limits for BOD_5, NH_3, fecal coliform and toxicity in the recent past. A reconnaissance study will be conducted after the facility comes into compliance with its 1995 permit limits to determine the effect of the discharge on the stream.

Subbasin 12 (Rocky River) This subbasin includes Rocky River to its confluence with the lower Deep River. The Rocky River watershed has a proliferation of single family residence and other small discharges. There are at least 16 single family residences discharging, and a potential for additional unpermitted discharges of this nature in the watershed. The localized impacts of these discharges are significant because most of the outfalls are located in zero flow streams. Water quality in this watershed would benefit from more extensive regional wastewater treatment. The larger treatment facilities in this area, such as Pittsboro WWTP or Siler City WWTP should make efforts to provide service to the lower areas of the watershed, and small discharges should be encouraged to connect to regional facilities as soon as service becomes available. If the Pittsboro WWTP were to extend a sewer interceptor south down Highway 15/501 several of the small discharges could potentially be eliminated.

Loves Creek/Rocky River

Siler City discharges to Loves Creek, a tributary of the Rocky River downstream of the Siler City Reservoir. Water quality is impaired in Loves Creek, the Rocky River below the dam and below the confluence with Loves Creek. Low DOs (less than 5 mg/l) and algal blooms have been observed. A biological assessment of Loves Creek resulted in a Poor rating with effects of the discharge evident in Rocky River 3 miles below the confluence with Loves Creek.

A QUAL2E model was developed for the Rocky River beginning at Siler City's discharge on Love's Creek and continuing 21 miles below the discharge point based on Black and Veatch's TOT study in 1988. DWQ calibrated the model and prepared a WLA Modeling Analysis in 1990 which required advanced tertiary limits at Siler City to improve the instream DO in the Rocky River (NC DEM, 1991). The model predicted that with advanced tertiary treatment the DO standard of 5 mg/l would be violated downstream of the WWTP. The 1990 model predicted a DO sag to 4.6 mg/l 3 miles below the discharge; a DO sag to 4.1 mg/l is predicted using the long term BOD results from 1993.

In addition, an instream flow study was undertaken by Water Resources in order to determine an appropriate minimum release from the Siler City Reservoir. A minimum release from the reservoir was recently required that should mitigate impacts from the Siler City WWTP, improve aquatic habitat, and reduce stagnant conditions in the Rocky River.

Siler City has expanded its WWTP to 4 MGD and upgraded the facility to meet advanced tertiary treatment levels recommended by the modeling analysis. Implementation of the minimum release from the Siler City Reservoir should mitigate the effects of the discharge. Water quality is expected to improve substantially due to the minimum release and improved treatment. Siler City's self-monitoring data show DO levels as low as 3 mg/l in Rocky River below the Siler City WWTP discharge. Follow up studies should be performed once the minimum release is operational to determine if stream improvement has occurred.

6.3.7 Recommended BOD and NH3 Strategies for the Upper Cape Fear Watershed (Subbasin 07, 13, 14 and 15)

Subbasin 07

Cape Fear River

This subbasin is the uppermost basin of the Cape Fear River. Within this subbasin, the Haw and Deep Rivers join to form the Cape Fear. There are a number of industrial and domestic discharges to the Haw River between Jordan Reservoir and the mouth of the Deep River, three of which have significant amounts of oxygen demanding waste. An empirical model of these discharges has been developed to gauge potential interaction between them and predict their collective impact on instream dissolved oxygen. The model was run from Allied-Signal's discharge point to Buckhorn Dam, 7.5 miles downstream in the headwaters of the Cape Fear River. The discharges included in the model are summarized in the following table:

Table 6.10 Discharges to Haw River below Jordan Reservoir

FACILITY	PROCESS (source of wastewater)	Wasteflow (MGD)	BOD_5 (mg/l)	DO (mg/l)
Allied-Signal, Inc.	Polyester fiber production	0.244	15.8	NL
Williamette Industries, Inc.	100% domestic waste stream	0.008	30	5.0
Neste Resins Corporation	Synthetic resin production	0.100	34.9	NL

None of these facilities have NH_3 limits nor discharge significant amounts of NH_3, so nitrogenous BOD (NBOD) was not a significant factor in the model. The model predicted that CBOD from the discharges had the most significant affect on instream DO levels. Due to uncertainty concerning the decay rate of the effluent from Neste Resins, the model was run under various scenarios of CBOD. All model runs predicted a DO sag below 5.0 mg/l behind Buckhorn Dam.

The model predicts that if all three facilities discharge at maximum permitted levels while Jordan Dam is at the minimum release level (40 cfs) there will be a violation of the 5.0 mg/l instream dissolved oxygen standard, which indicates a potential overallocation of assimilative capacity in this area of the Haw and Cape Fear Rivers. Discharger impact may be mitigated by increased flow releases from Jordan Dam. Instream data are limited, however, at Moncure, the ambient DO has been observed at 5.6 mg/l. Further downstream at HWY 42 (1.5 miles above Buckhorn Dam), the DOs indicate supersaturation typical of algal blooms.

Upon expansion, more stringent BOD limits may be applied to protect the instream DO standard. It should be noted that assimilative capacity is somewhat limited in this area because the river has a low slope (1.0 ft/mi.) and slow velocities which cause reaeration rates to be low, so oxygen demanding wastes decay very slowly. In addition, the BOD from the industries breaks down slowly so there is residual BOD behind the dam. A long term BOD sample was taken from the mouth of the Haw River in order to assess the impact of these discharges and quantify loading to the Cape Fear at Buckhorn Dam. Results indicate that the CBOD at the mouth of the Haw River (6.1 mg/l) is well above typical background levels of CBOD (2 mg/l).

Kenneth Creek

Fuquay-Varina discharges 1.2 MGD of municipal wastewater to Kenneth Creek, a tributary of Neils Creek. At the point of Fuquay-Varina's discharge the creek has a drainage area of 4.0 square miles and has a zero flow 7Q10, but has positive flow for 30Q2. Benthic macroinvertebrate sampling gave the creek a rating of Poor, and attributed the degradation of the stream directly to impacts of the Fuquay-Varina discharge. Fish community sampling also yielded a Poor rating for Kenneth Creek. Water quality ratings in Neils Creek recover to Good-Fair prior to confluence with the Cape Fear. Fuquay-Varina has documented DO concentrations as low as 3.8 mg/l below the discharge during the summer of 1994. It is recommended that new and expanding discharges meet advanced tertiary limits of 5 mg/l BOD_5 and 2 mg/l NH_3-N.

Utley Creek

Holly Springs discharges to Utley Creek, a low flow tributary of Harris Lake. Holly Springs' self-monitoring data show DO levels as low as 4.8 mg/l in Utley Creek below the Holly Springs WWTP discharge. A survey of water quality below the discharge is recommended since the instream waste concentration is 87.5%. If Holly Springs pursues expansion at this location, a field calibrated model may be developed in order to determine appropriate permit limits.

Subbasin 13 This subbasin includes the Upper Little River watershed which drains to the Cape Fear River. There is no interaction between discharges to this low flow stream. There are no known water quality problems in this watershed.

Subbasin 14 This subbasin includes the Lower Little River watershed. The river is HQW above Fort Bragg's discharge. An empirical model was run to examine the potential for interaction between the discharges for Dilton Mobile Home Park, Fort Bragg WWTP and the Town of Spring Lake WWTP. The model was run to simulate the cumulative impact of the discharges if all facilities discharged at maximum permitted levels during 7Q10 conditions. The model was developed with the discharge parameters listed in the following table:

Table 6.11 Discharges to Little River

FACILITY	Flow (MGD)	BOD_5 (mg/l)	NH_3N (mg/l)	DO (mg/l)
Dilton Mobile Home Park	0.015	30	NL	NL
US Army - Fort Bragg WWTP	8.0	16/30	11/NL	5/NL
Town of Spring Lake WWTP	1.5	28/30	8/NL	5/NL

The model was run from the outfall point of Dilton MHP to a point on the Little River about 2.5 mi. below the confluence with Jumping Run Creek and accounts for the presence of a large drinking water treatment plant, serving Fort Bragg, located in this area of the river. The treatment plant's intake is located upstream of Dilton MHP and the Fort Bragg wastewater discharge, and it is permitted to withdraw up to 8.0 MGD. The maximum withdrawal can constitute as much as 30% of the river's flow during a 7Q10 event, so the water plant can have a direct impact on the assimilative capacity and the wasteload allocations in the stream.

The model predicts a significant over allocation of the Little River in the Spring Lake area, and the model attributes it almost entirely to the Fort Bragg WWTP. However, ambient data and biological sampling data indicate that water quality has improved in this area of the Little River, most likely due to the fact that the US Army completed an upgrade of the Fort Bragg WWTP in summer of 1991. Even though BOD_5 and NH_3-N limits have been 16/30 mg/l (sum/win) and 11/NL mg/l, the plant has been treating to tertiary levels since the WWTP upgrade. No instream violations of the DO standard have been observed.

In light of their current treatment performance, Fort Bragg WWTP's BOD5 limit will not be changed at this time. Upon renewal, the facility will receive ammonia limits according to current DWQ ammonia toxicity policy. Per the modeling, it is recommended that new and expanding discharges to the Little River receive summer limits no less stringent than 10 mg/l BOD_5 and 4 mg/l NH_3-N to protect the 5.0 mg/l instream dissolved oxygen standard.

Subbasin 15 This subbasin includes the Cape Fear River from Erwin to Lock & Dam 3 as well as Rockfish Creek. Modeling for this section of the river is described in Section 6.3.3.1.

6.3.8 Recommended BOD and NH_3 Strategies for the Lower Cape Fear Watershed (From Lock and Dam No. 1 to the mouth) and Coastal Waters (Subbasins 16, 17 and 24)

Subbasin 16 This subbasin includes the Cape Fear River from Lock and Dam 3 to Lock and Dam 1 including Elizabethtown. Modeling for this section of the river is described in Section 6.3.3.2.

Subbasin 17 This Subbasin can be broken into three distinct areas:

1. Cape Fear between Lock and Dam 1 and Wilmington: A QUAL2E model was developed for this section of the river and is described in Section 6.3.3.3.
2. Northeast Cape Fear from Castle Hayne to Wilmington: Low DOs (4-5 mg/l) have been observed at the ambient station at HWY 421.
3. Cape Fear from Wilmington to the Ocean: Low ambient DOs (2-3 mg/l) have been recorded at the ambient stations at Channel Markers 55 & 50.

WLA analyses in estuarine areas are more complex than those to river systems due to the tidal and wind effects on the hydrology and the three-dimensional circulation patterns. Due to the time and resource constraints, a comprehensive estuary model was not developed for inclusion in this plan. However, monitoring regimes are being developed and results are planned to be available by the next permit cycle to evaluate the current pollutant loads and water quality and to determine the status of Primary Nursery Areas (PNAs). A coalition of industries, municipalities, and educators has evolved to develop a monitoring program. UNC - Wilmington is overseeing the group and performing the monitoring. As a result of documented low dissolved oxygen levels and pending completion of further studies, it is recommended that new and expanding discharges in the estuary area receive NPDES limits reflecting advanced wastewater treatment, i.e., BOD_5 = 5 mg/l and NH_3-N = 2 mg/l. This area is heavily used for wastewater assimilation and is susceptible to strong development pressure.

A section of this subbasin was reviewed for reclassification to HQW in 1989 based on the presence of PNA waters. The EMC recommended additional surveys of water quality and aquatic life be undertaken prior to making a final decision. The UNC -Wilmington, Dept. of Marine Sciences was delegated to undertake the sampling. The area under consideration includes the Northeast Cape Fear from the mouth of Ness Creek to the Cape Fear, the Brunswick River, and the Cape Fear River from the Black River to a line across the river upstream of Lilliput Creek. Data from these surveys will be reviewed prior to the next basin plan to determine what changes in the study plan are needed.

The Corps of Engineers and the NC Division of Water Resources is investigating the feasibility of deepening the Wilmington harbor to allow access to larger ships. Studies are focusing on the effects of the dredging on the ground water system. The impacts on salt water intrusion upstream have not yet been quantified.

<u>New Hanover County</u>

New Hanover County has recently purchased the wastewater treatment facilities for several subdivisions located on the north side of the county and plans to regionalize wastewater treatment. Regionalization will be achieved in the short run through connection to one of Wilmington's regional wastewater treatment plants. The long-term solution is construction of the 4.0 MGD new Hanover County WWTP to serve northern New Hanover County. The proposed facility has been permitted to discharge to the Cape Fear River below the confluence with the Northeast Cape Fear with requirements for advanced tertiary treatment, i.e., summer (winter) limits of BOD_5 = 5 (10) mg/l and NH_3-N = 2 (4) mg/l.

Subbasin 24 This subbasin is a small coastal watershed which includes the Intracoastal waterway, beach communities, and Topsail Island. There are many SA waters and ORW waters. Most water quality problems can be traced to development and marinas. Discharges are discouraged to all waters. DO levels drop below 5 mg/l during summer months due to high temperatures and limited tidal flushing. Biological Assessment has sampled in this subbasin as part of its efforts to improve estuarine survey techniques and rating methods.

6.3.9 Recommended BOD and NH_3 Strategies for the Black River Watershed (Subbasins 18, 19 and 20)

Subbasins 18, 19 and 20 The South River (subbasin 18) from Big Swamp to the Black River and the Black River (subbasins 19 and 20) from it's source to the Cape Fear River have been designated ORW. All of the protective measures included in the ORW management strategy will apply to these waterbodies. No new discharges or expansion of existing ones are allowed in ORW stream segments as per 15A NCAC 2B .0216 (c) (1).

The following point source management strategies are recommended 1 mile upstream of the ORW stream segments. These management strategies are in accordance with 15 NCAC 2B .0203 and 15 NCAC .0216 (e) (9).

(A) All new and expanded NPDES wastewater discharges will be required to meet summer (winter) effluent limitations of BOD5 = 5(10) mg/l, NH3-N = 2(4) mg/l.

(B) Fail-safe treatment designs will be employed including stand-by power capability for entire treatment works, dual train design for all treatment components, or equivalent fail-safe treatment designs.

A number of municipalities: Clinton, Garland, Magnolia, Roseboro, and Warsaw discharge to swamp waters in subbasin -19. Naturally occurring low DOs are typical for these systems. For example, DOs less than 3 mg/l have been observed above and below the Magnolia WWTP. White Lake also discharges to swamp waters (Colly Creek) in subbasin -20. A major concern in these subbasins is the application of the desktop empirical model to swamp waters. The model should be used with caution as it was developed for free-flowing streams and assumes complete mixing across the waterbody. See Section 6.3.2 for a description of management for swamp waters. In addition, a number of these facilities are currently operating under SOCs which allow the discharge of effluent of lesser quality than the permit limits require. The facilities are scheduled to be in compliance in 1995 or 1996.

6.3.10 Recommended BOD and NH_3 Strategies for the Northeast Cape Fear Watershed (Subbasins 21, 22 and 23)

Subbasin 21 This subbasin contains the headwaters of the Northeast Cape Fear River within a very small drainage area. The major concern as a result of its impact on the biological community and instream DO is the Mount Olive Pickle Plant which discharges 0.4 MGD of industrial wastewater to Barlow Branch, a zero 7Q10 and zero 30Q2 tributary of the Northeast Cape Fear River. The facility has received limits of BOD_5 = 6 mg/l and NH_3-N = 2 mg/l. However, these limits do not protect water quality due to the high strength of the wastewater, i.e., CBOD is 6 mg/l BOD_5* 5.6 (ratio of CBOD/BOD_5) = 33.6 mg/l compared to domestic strength of 6 mg/l BOD_5* 1.5 (ratio of CBOD/BOD_5) = 9 mg/l. In addition, Mount Olive Pickle is under an SOC until 12/31/96 which allows the discharge of BOD_5, NH_3, and TSS above the permitted limits. Anoxic conditions periodically occur downstream of the pickle plant while the DO concentration averages approximately 4 mg/l. Impacts are seen for over 4 miles of the Northeast Cape Fear River an improvement over past sampling efforts. Additional information on the impacts of the discharge can be found in Section 6.5 addressing toxicant conditions.

Subbasin 22 This subbasin drains most of the NE Cape Fear. The river and its tributaries are swamp waters and blackwater which possess naturally low DOs (<4 mg/l). The NE Cape Fear is classified HQW from Muddy Creek to Rock Fish Creek. DOs drop to 4-5 mg/l at HWY 41 near

Chinquapin. Tributaries have limited assimilative capacity for major discharges and tertiary treatment has been required in most cases based on localized water quality problems.

Panther Branch

A major concern due to its impact on the biological community and instream DO is the Cates Pickle Plant which discharges 0.5 MGD of industrial wastewater to an unnamed tributary of Panther Branch, a zero 7Q10 and zero 30Q2 stream which flows to Goshen Swamp in the Northeast Cape Fear River drainage basin. The facility has received limits of BOD_5 = 5 mg/l and NH_3-N = 2 mg/l per zero flow regulations.

Subbasin 23 This subbasin includes the Lower NE Cape Fear River which is classified swamp waters. The Biological Assessment group has been collecting data here as part of its swamp study to refine methods of rating swamp waters. Most waters are rated fair and good-fair. DOs at the ambient station at HWY 117 drop to 3-5 mg/l during summer months due to the influence of the discharges, the salt wedge, swamp waters, and high temperatures. The former Ammons - Northchase WWTP (now Bridgeport), has been purchased by New Hanover County with plans to connect it to a regional treatment plant.

Osgood Canal/Burgaw Creek

The Town of Burgaw wastewater treatment plant is permitted to discharge up to 0.5 MGD to Osgood Canal 1/2 mile above its confluence with Burgaw Creek, which flows through a slow moving swamp area to the Northeast Cape Fear River. At the point of Burgaw's discharge, Osgood Canal is estimated by US Geological Survey to have zero flow during 7Q10 flow conditions and minimal positive flow (0.4 $ft.^3$/sec.) during 30Q2 flow conditions. Biological sampling of benthic macroinvertebrate and fish communities done in 1987 and 1985, respectively, has shown Burgaw Creek to be substantially impaired by the discharge. During summers from 1991 to 1993, the Burgaw WWTP had 7 effluent violations of the monthly BOD_5 limit and 8 violations of the NH_3-N limit. The facility is currently under a Special Order by Consent which allows relaxed limits for BOD_5 and NH_3-N, and requires compliance with final NPDES effluent limitations by June 30, 1996. The Town of Burgaw has submitted a 201 Plan and Environmental Assessment which evaluated the alternatives of expanding the treatment plant at the current discharge location, relocating the discharge to the Northeast Cape Fear River at NC Highway 53, and land application of the discharge. The plan selects upgrading and expanding the WWTP to 1.0 MGD at the current discharge location. Speculative limits provided to Burgaw for planning purposes were advanced tertiary treatment limits of BOD_5 = 5.0 mg/l (summer) and 10.0 mg/l (winter) and NH_3-N = 2.0 mg/l (summer) and 4.0 mg/l (winter) with a minimum effluent dissolved oxygen limit of 6.0 mg/l for the expansion to 0.75 MGD.

6.4 MANAGEMENT STRATEGIES FOR NUTRIENTS

Control of nutrients is necessary to limit algal growth potential, to assure protection of the instream chlorophyll *a* standard, and to avoid the development of nuisance conditions in the state's waterways. Point source controls are typically NPDES permit limitations on total phosphorus (TP) and total nitrogen (TN). Nonpoint controls of nutrients generally include best management practices (BMPs) to control nutrient loading from areas such as agricultural land and urban areas.

6.4.1 Assimilative Capacity

The Cape Fear River basin has limited areas where eutrophication problems exist. The Jordan Reservoir watershed (subbasins 01 through 06) has limited assimilative capacity for nutrients and has been designated NSW. Due to its physical and geographical characteristics, the lake is especially susceptible to degradation from excessive nutrient loadings. Eutrophic conditions are well documented throughout the lake during summer conditions (See data summaries, Chapter 4). The Deep River has been identified as impacted based on excessive nutrient loading and subject to eutrophication in stagnant areas. At this time the Cape Fear mainstem has not been overallocated for nutrients though instream levels of nutrients are high.

6.4.2 Management of the Jordan Reservoir Watershed: Subbasins 01-06

NCDWQ first recommended nutrient management in the Jordan Reservoir watershed in 1983. NCDWQ recognized the need for watershed-wide nutrient management in the watershed and developed a Nutrient Sensitive Water (NSW) strategy. Effluent TP limits of 2.0 mg/l were applied to all new or expanding discharges in subbasins 01 through 06. Existing facilities with design flows of 50,000 gallons per day and greater were given until January 1990 to come into compliance with the TP limit (2 mg/l). Currently a majority of the facilities have done so.

In addition to the NSW strategy, more stringent TP limits, as well as possible establishment of TN limits, have been necessary in localized areas including a number of tributaries to Jordan Reservoir. While the NSW designation was designed to protect the watershed as a whole on an annual basis, some localized areas are much more impacted by a constant discharge. Through modeling analyses and detailed monitoring, it is evident that eutrophication problems (i.e., algae blooms, nuisance conditions, etc.) are common in areas where a discharge dominates a low flow stream, especially above lakes or other impoundments. Currently, the Division procedure is to assign more stringent nutrient limits where it can be shown that during summer low flow periods the discharge is directly impairing the water quality of the receiving water. Nutrient strategies for the major tributaries of Jordan Reservoir are discussed below.

Haw River

The many small dams located on the Haw River present the potential for algae growth by slowing water velocity. Nutrient concentrations, both nitrogen and phosphorus, are very high throughout subbasin 02, due to the presence of a number of major wastewater discharges in addition to nonpoint sources. Nutrient loading is particularly high on Reedy Fork Creek which is dominated by wastewater from Greensboro and Cone Mills. Although no algae blooms have been reported on Reedy Fork Creek, EPA Algal Growth Potential Test data show Reedy Fork Creek at Ossipee and the Haw River at Glencoe and at Saxapahaw are highly nutrient enriched and have strong potential for algal growth in the absence of limiting factors. Currently growth may be limited by the color, foam, and short residence time behind the dams. EPA testing ruled out metals toxicity as a limiting factor for algal growth. The ratio of nitrogen to phosphorus at these stations indicates nitrogen limitation.

In addition, analysis of nutrient data taken by DWQ personnel during a time-of-travel study on June 7-9, 1994 shows elevated nutrient concentrations in both the Haw River and its tributaries, including Reedy Fork Creek and Alamance Creek. A mass balance identifies Reedy Fork Creek as a major source of nutrients to the Haw River, with loading rates 2.5 times higher than any other source. These data and ambient monitoring data indicate the NSW strategy is not sufficiently controlling nutrient loading to the Haw River. Plots of nutrient concentration versus flow taken at DWQ ambient monitoring stations at Haw River and Bynum show high nutrient concentrations at both high and low flows, implicating both point and nonpoint sources. Development of a nutrient fate and transport model is recommended to better identify both point and nonpoint sources and re-evaluate the NSW management strategy. Modeling is also needed to identify the relative contributions of point and nonpoint sources. Due to the significance of wastewater in the Haw River (Instream waste concentration of over 66% at Bynum), more stringent nutrient limits may be needed to reduce the potential of algal blooms in Jordan Reservoir.

New Hope Creek

A water quality study of New Hope Creek in 1988 indicated that little or no assimilation of nutrients was occurring in the channel above Jordan Reservoir. Bioavailable and chemical nutrient data indicated that virtually all of the effluent input remains available for biological uptake (NC DEM, 1989). As a result of observed nutrient concentrations, chlorophyll *a* levels and algal growth potential, phosphorus removal to 0.5 mg/l during summer months was required upon expansion of the Durham-Farrington Road WWTP. In addition, biological nitrogen removal was recommended to reduce eutrophication in the New Hope arm of Jordan Reservoir. A detailed description of the nutrient analysis can be found in a separate report (NC DEM, 1989).

Northeast Creek

Effluent and instream nutrient studies were conducted on Northeast Creek in 1990. As a result of observed nutrient concentrations, chlorophyll *a* levels and algal growth potential, phosphorus removal to 0.5 mg/l during the summer months was required of the Durham-Triangle WWTP.

Morgan Creek

A water quality study of Morgan Creek in 1989 indicated that OWASA's effluent dominates Morgan Creek during the critical low flow summer period. A reduction in OWASA's nutrient concentrations was needed to reduce the potential for eutrophication below the OWASA facility (NC DEM, 1991). As a result of observed nutrient concentrations, chlorophyll *a* levels and algal growth potential, phosphorus removal to 0.6 mg/l during summer months was required upon expansion of the Mason Farm WWTP to 10 MGD. The eutrophication issue will be reevaluated for the next expansion phase. A detailed description of the nutrient analysis can be found in a separate report (NC DEM, 1991).

6.4.3 Management of the Deep River watershed (Subbasins 08 to 11)

Overview

The upper reaches of the Deep River contain the drainage areas of High Point Lake and Oak Hollow Lake. Algae blooms have been reported in these reservoirs, but they are currently supporting their designated uses. DWQ ambient nutrient data, taken at the USGS flow gage on the East Fork Deep River, show high nutrient concentrations at both high and low flows and indicate the influence of both point and nonpoint sources. A few small point source discharges may contribute to the nutrient loading, but there are no major discharges above these lakes. Both agricultural and urban nonpoint source pollution controls should be implemented to protect these two reservoirs from further eutrophication.

Below Richland Creek, nutrient concentrations within the entire Deep River, especially phosphorus, are excessively high. Total phosphorus and total nitrogen concentrations are measured at three ambient stations with USGS gages. At Coltranes Mill, downstream from High Point's Eastside WWTP, high concentrations of nutrients occur at low flows when nonpoint source input is minimal, indicating water quality in this reach is strongly influenced by point sources. At permitted flow (16 MGD), effluent from the Eastside WWTP constitutes over 70% of the Deep River flow. Other discharges above Coltranes Mill have a total permitted discharge of only 0.085 MGD. At the Ramseur ambient station both point and nonpoint sources contribute to high nutrients, while at the Moncure station, in the lowest reaches of the Deep River, most of the nutrient load is delivered at high flows. Field observations suggest this is caused by both nonpoint source pollution and the resuspension and washout of stored sediments from impoundments. Development of a nutrient fate and transport model of the Deep River is limited by the multitude of impoundments and the resulting complex, unsteady river discharge.

A DWQ study was conducted on the Deep River in September 1994 to determine the significance of upstream point sources on nutrient loads to the Carbonton impoundment (NC DEM, 1995). The study showed High Point's Eastside WWTP is a major contributor of nutrients to the upper Deep River. High concentrations of nutrients (maximum TP = 1.8 mg/l, maximum TN = 11.9 mg/l) were measured in the Deep River downstream from Richland Creek during low flow conditions. The concentrations drop rapidly until Ramseur, as the river is slowed by several dams and nutrients are retained in the impoundments. During higher flows, there is a large nutrient flux to downstream reaches. This is believed to be the result of both nonpoint sources and the flushing of nutrients stored behind the dams.

Nonpoint sources within the Deep River basin include urban, agricultural, and forestry operations. The headwaters of the Deep River receive runoff from Greensboro and High Point, and Hasketts Creek is impacted upstream of the WWTP by stormwater from Asheboro. Although there are these urban impacts, agriculture and forestry are the significant land uses in the basin. Agriculture consists mostly of poultry and cattle operations (Cooperative Extension Service, pers. comm.). Livestock manure and poultry litter are typically applied to pastures as organic sources of nutrients. While land application of waste is generally both economically and environmentally sound, this practice can result in the overapplication of phosphorus. Improper application rates and timing can leave excess nutrients that are not used by the plants. During rainstorms, these excess nutrients may be washed into nearby streams and lakes. Soil erosion from forestry and agricultural operations is also a concern, not only because of sedimentation of lakes, but because phosphorus is readily attached to soil particles. As sediment accumulates in impoundments, attached phosphorus can be released to the water.

Water quality problems from high nutrient concentrations are exacerbated by the many hydroelectric and mill dams on the Deep River. Additionally, several bridge crossings collect significant amounts of debris, further impounding the river. These impoundments slow water velocity and encourage algae growth during low flow events. Instream self-monitoring data from Asheboro WWTP show violations of the dissolved oxygen saturation standard (110%) in Cox Lake during summer months from 1991-1994. The elevated levels of DO saturation (as high as 174%) are indicative of algae blooms and overenrichment. Algae blooms have also been reported in the impoundments at Carbonton and Coleridge and significant periphyte growth has been noted by DWQ personnel throughout the lower Deep River below Franklinville.

Low dissolved oxygen concentrations in Cox Lake and the lower reaches of the Deep River are attributed to excessive algae and periphyte growth and die-off. Although nutrient concentrations in the upper reaches of the Deep River near High Point and Randleman are frequently sufficient to support algae blooms, water velocities are too high and retention times in the smaller impoundments are too low for significant algae growth. In the eastern, downstream reaches, the river bed slope is lower and water velocities are slow enough for algae growth during low flow conditions.

Management Strategies

Three factors, stream velocity, point source nutrient loading, and nonpoint source loadings, are predicted to play a significant role in the control of eutrophication and DO standards violations in the Deep River. A three-tiered management strategy is recommended.

1.) Maintenance of Stream Velocity

Restoring the natural riverine flow conditions will reduce algae blooms and improve river reaeration. As discussed before, algae require quiescent conditions for growth. Where possible, removing unnecessary impoundments, acquiring and removing hydroelectric dams, and eliminating debris snags will maintain water velocity at low flows and will immediately reduce algae blooms. As a condition of Federal Energy Regulatory Commission (FERC) permitting, dams along the Deep River are required to release the same flow that enters the impoundments instead of holding water for peak hydropower releases. In the past, many of the dams were operated in a peaking mode instead of run-of-the-river. Although flow peaking has been reduced, inadvertent flow fluctuations still exist due to failures and inadequacies of outdated equipment in many older hydroelectric facilities on the Deep River. These flow fluctuations further limit the system's assimilative capacity by reducing flow velocities behind the dams and total flow downstream. The Division of Water Resources (DWR) is currently working with hydropower operators to reduce these problems. Water level recorders have been installed at some hydropower facilities on the Deep River and operational evaluations by DWR are recommended during future low flow periods.

2.) Point Source Nutrient Control

Excessive algae growth can be prevented by limiting phosphorus. This is particularly true in the Deep River system where phosphorus, removed in the impoundments under low flow conditions, is resuspended and flushed downstream at higher flows. As discussed above, point sources, especially in the upper reaches, contribute a significant fraction of the phosphorus load to the Deep River. Comparisons of the average daily total phosphorus load from wastewater treatment plants above the Carbonton impoundment indicate the High Point Eastside WWTP contributes more phosphorus to the Deep River than all other discharges combined. Due to the size of the High Point discharge and the extremely high phosphorus concentrations measured in the Deep River downstream from Richland Creek (as high as 3 mg/l), it is recommended that High Point Eastside take immediate steps to reduce phosphorus loading. A total phosphorus (TP) discharge limit of 1.0 mg/l is recommended. DWQ will work with the facility to determine an appropriate schedule for these changes. It is also recommended that all other new and expanding major discharges (flow >= 1 MGD) receive a TP limit of 1 mg/l, while discharges with a discharge less than 1.0 MGD and greater than or equal to 0.5 MGD receive effluent TP limits of 2 mg/l. This should reduce permitted point source phosphorus loading above Carbonton Lake by 73%. This should result in an overall reduction of at least 30% in average instream summer TP concentrations at the ambient station at Ramseur.

Additionally, DWQ's studies have shown excessive levels of nitrogen loading in the upper Deep River system. Instream data from the Deep River mainstem 1.5 miles downstream of the High Point - Eastside WWTP discharge have shown combined nitrate-nitrate levels as high as 19.0 mg/l. Ambient data from the Deep River at Coltrane's Mill, 5 miles below the Eastside WWTP discharge, has shown total nitrogen (TN) levels as high as 16.0 mg/l. As with phosphorus, instream TN levels are dramatically higher during low flows, indicating that point sources are the dominant nitrogen loading contributions in this area. The High Point - Eastside WWTP constitutes over 99% of all wastewater discharged from point above Coltrane's Mill. Therefore, in order to reduce the incidence of nuisance algae blooms downstream in the Deep River, it is recommended that, upon expansion, the Eastside WWTP be required to meet an effluent TN limit of 6.0 mg/l during summer month (April-October).

3.) Nonpoint Source Nutrient Control

While reducing point source loading to the Deep River will significantly reduce nutrient concentrations, nonpoint source controls are also necessary to minimize the occurrence of algae blooms under low flow conditions. Urban nonpoint source pollution will be reduced in the headwaters of the Deep River as the Greensboro stormwater plan is implemented. Richland Creek and Hasketts Creek upstream from the municipal WWTPs should continue to be monitored and these two urban tributaries should be reassessed in the next basin plan.

Nutrient loading from land application of animal wastes should be reduced as a result of the 15A NCAC 2H.0217 rules. Effective December 31, 1997, existing animal operations with liquid waste collection systems above a threshold size must provide certification of an animal waste management plan to DWQ. Other systems are required to apply animal wastes at agronomic rates, to keep records of waste disposal for a year, and to maintain 100 foot setbacks from perennial waters for waste storage areas. DWQ is currently working with the Cooperative Extension Service to increase education on the proper handling, storage, and application of wastes, as well as the implementation of nutrient management plans, erosion control measures, and other agricultural BMPs. Additionally, due to the numerous algae and dissolved oxygen problems resulting from excessive nutrient concentrations, the Deep River basin, from High Point Lake to Carbonton dam, should receive high priority within the Cape Fear basin for 319 and cost share funding.

A statewide nonpoint source work group was recently formed to combine the efforts of agencies involved in NPS control. Basin teams will be formed by representatives from each agency to develop nonpoint source management strategies for each river basin. It is anticipated that these teams will provide information from their respective programs that apply to protection of water quality in the basin. Further they will help develop and implement strategies to restore targeted impaired streams as identified in Tables 6.1 and 6.2 of this chapter. A team will be formed for the Cape Fear basin during the next five years. In light of the size and variation of water quality concerns in the basin, sub-teams may also be established for such areas as closed shellfish waters in the coastal portion of the basin and nutrient-related problems in upper reaches of the basin. For example, DWQ anticipates providing information on the Deep River water quality problems to this work group to encourage focused multi-agency attention and efforts in this area.

Lastly, DWQ will work to further quantify nutrient loading to the Deep River and to monitor long-term changes in phosphorus and nitrogen concentrations and fluxes. This could include the relocation of the ambient water quality monitoring station at High Falls to the new USGS gage at Glendon to improve the quantification of mainstem nutrient fluxes.

Proposed Randleman Reservoir

During the summer of 1983, an intensive water quality survey was conducted on the Deep River headwaters. One study intent was an assessment of potential water quality impacts of the proposed 3,000 acre water supply reservoir, the Randleman Reservoir, which would inundate much of the 25 miles of the Deep River study area in Guilford and Randolph counties. It was found that the elevated phosphorus and nitrogen levels in the Deep River could have a significant effect on the proposed Randleman Lake's trophic status (NC DEM, 1985). The report recommended diverting the major discharges around the lake in order to greatly reduce nutrient loading. Modeling indicated that point sources would be the dominant source of nutrients with over 90% of phosphorus inflow from High Point and Jamestown.

A second modeling study of the proposed lake was undertaken in 1990 as part of the Environmental Impact Statement. An Army Corps of Engineers BATHTUB model was developed which relies on loading estimates of point and nonpoint sources of nutrients to calculate total phosphorus and chlorophyll *a* concentrations within the lake as a growing season average. Under all model scenarios with the High Point - Eastside discharge, nuisance algal blooms are predicted to occur. Blooms may be exacerbated be the long retention time of the lake. Under average flow conditions, retention is predicted to be 229 days.

The existing land use for the watershed is 52% forested and 21% developed. The future scenario assumes forest and pasture land will be developed. Under this scenario, the watershed is 14% forested and 78% developed. With the increase in impervious service (from 11% to 32%), runoff and nutrient load to the lake increase. The future scenario also assumes the WWTP will expand to 20 MGD and remove phosphorus to 0.5 mg/l. Under this scenario there is a shift in nutrient loading from point source dominated to nonpoint source dominated. The overall TP load to the lake decreases by 42% and TN loading increases by 41.5%. Under this scenario, the model predicts mean chlorophyll *a* in the lake segment below the WWTP will range from 75 - 86 ug/l with nuisance algal blooms predicted to occur 80-86% of the time. The lakewide average chlorophyll *a* is predicted to be 22 ug/l with an algal nuisance frequency of 11%. If the High Point discharge is eliminated from the lake, the percentage of nuisance algal blooms in the upper Deep River arm is predicted to be reduced to between 50 and 71% (PTRWA, 1990).

The Final EIS also compares the lake-wide average predicted chlorophyll *a* of Randleman Reservoir to lakes sampled for DWQ's 1988 Lakes Report. Water quality in Randleman Reservoir will be within the range of values measured in other NC lakes that are all eutrophic. From the model results, it is highly likely that Randleman Reservoir will be eutrophic as well.

In 1991, after reviewing supporting information, the EMC approved the Randleman Reservoir thereby permitting the Piedmont Triad Regional Water Authority to purchase land for the project through eminent domain. A petition contesting the EMC decision was filed in March 1992 by landowners whose land would be taken by the Piedmont Triad Regional Water Authority and a public interest group with concerns about the proposed reservoir as a safe drinking water source. The reservoir project has been investigated and evaluated, and the EMC decision was overturned by a Superior Court judge in 1994 in favor of the landowners. The judge recognized in his decision that not only are the low inflows, eutrophication potential, and the direct discharge to the lake by the High Point WWTP all concerns, but that alteration of natural flow patterns in the river could have significant impact for miles downstream. The EMC has appealed the ruling against the reservoir to the NC Court of Appeals.

6.4.4 Rocky River Watershed: Subbasin 12

A nutrient budget was done for the Rocky River Subbasin due to persistent algal blooms on the Rocky River downstream of the Siler City WWTP. The analysis recommended that Siler City implement phosphorus removal (0.5 mg/l) upon expansion in order to reduce the potential for algal blooms (NC DEM, 1991). The nutrient budget indicated that under summer low flow conditions nutrient loading was due to point sources.

6.5 TOXIC SUBSTANCES

Toxic substances routinely regulated by NCDWQ include metals, organics, chlorine and ammonia. Section 3.2.3 of the basin plan describes toxic substances.

6.5.1 Assimilative Capacity

The assimilative capacity, the amount of wastewater the stream can assimilate under designated flow conditions (7Q10 for aquatic life based standards, average flow for carcinogens), available for toxics in the Cape Fear Basin varies from stream to stream. In larger streams where there is more dilution flow, there is more assimilative capacity for toxic discharges. In areas with little dilution, facilities will receive chemical specific nutrient limits which are close to the standard. Toxics from nonpoint sources typically enter a waterbody during storm events. The waters need to be protected from immediate acute effects and residual chronic effects.

6.5.2 Control Strategies by Subbasin

Point source discharges will be allocated chemical specific toxics limits and monitoring requirements based on a mass balance technique discussed in the Instream Assessment Unit's Standard Operating Procedures manual and in Appendix III of this report. Any available data are used at permit renewal to determine which toxic parameters need to be limited in the NPDES permit. Whole effluent toxicity limits are also assigned to all major discharges and any discharger of complex wastewater.

Nonpoint source strategies to be implemented through the municipal and industrial NPDES stormwater program should also be helpful in reducing toxic substance loading to surface waters. Industries are being required to control runoff from their sites and to cover stockpiles of toxic materials that could pose a threat to water quality. Greensboro, Fayetteville, and Cumberland County will also be implementing stormwater programs that will include identifying and removing illicit discharges to storm drain systems. Additional strategies for streams not meeting instream standards or action levels are discussed by subbasin below:

Subbasin 01

The City of Reidsville WWTP currently discharges 5.0 MGD to Little Troublesome Creek for an instream waste concentration of 98%. More than 60% of the treatment plant inflow is from industrial sources. Prior to June 1994, the facility had never passed a toxicity test at the permit limit, Quarterly Chronic *Ceriodaphnia* Pass/Fail at 90%, despite over 4 years of monthly testing. Most tests in that period indicated that the effluent would exhibit toxicity to aquatic organisms at effluent concentrations of 35% or more. The facility is currently under an SOC which requires full compliance with the current test limit by December 1995 and requires a Toxicity Identification Evaluation (TIE) and a Toxicity Reduction Evaluation (TRE) be completed. To date all requirements of the SOC have been met. Reidsville has been considering relocation of its outfall to the Haw River at NC HWY 150 as an alternative to full toxicity reduction. By obtaining more dilution, the facility will receive a less stringent toxicity test requirement. The IWC at the Haw River site will be 51% at 5 MGD (61% at 7.5 MGD). However, with implementation of the Phase II TRE recommendations, toxicity test results have improved significantly and the facility may soon achieve compliance with its current NPDES toxicity limit. Since June 1994, the facility has reported chronic toxicity at effluent concentrations greater than 90% for 7 of 10 tests.

Subbasin 02

Buffalo Creek

Cone Mills discharges 1.1 MGD of textile waste to North Buffalo Creek, a low flow stream. The facility has an inconsistent record of compliance with its quarterly toxicity tests. In addition, Greensboro discharges 16 MGD of municipal wastewater to North Buffalo Creek downstream of Cone Mills. The City is required to meet limits close to the standards for effluent metals due to lack of instream dilution (IWC=96%). Poor water quality has been documented downstream of both the Cone Mills and Greensboro North Buffalo WWTPs. Discussions are underway between the City of Greensboro and Cone Mills to enable the removal of the Cone Mills discharge through connection to the Greensboro T.Z. Osborne WWTP. Regionalization of wastewater treatment and disposal is recommended. Water quality in North Buffalo Creek is expected to improve with the removal of the Cone Mills discharge.

Greensboro's T.Z. Osborne WWTP discharges 20 MGD of municipal wastewater to South Buffalo Creek. The City is required to meet limits close to the standards for effluent metals due to lack of instream dilution (IWC=94%). Poor water quality has been documented downstream of the T.Z. Osborne WWTP. An expansion to at least 30 MGD is planned. Improvements to effluent quality are recommended at both of Greensboro's WWTPs since these waters are the headwaters of the Haw River and significantly impact the Haw River water quality.

Haw River
The Haw River receives toxic loads from the Burlington WWTPs, Burlington Industries, Graham WWTP, Dixie Yarns, Mebane WWTP, and Reedy Fork Creek. There is a high instream waste concentration below these facilities and interaction between discharges. Metals limits will be reallocated upon permit renewal to account for interaction between discharges to the Haw River near Burlington.

Richland Creek/Deep River
Though water quality in the upper Deep River has improved from poor to fair between 1983 and 1993, an intensive water quality survey conducted by DWQ in 1992 indicates water quality violations remain. Most improvement appears to be correlated with removal of the Jamestown WWTP. The 1992 study found metals concentrations exceeding the action levels for copper, zinc, and iron in the upper Deep River site downstream of the High Point Eastside WWTP. Copper and zinc were found in association with the High Point Eastside WWTP. The facility is currently in compliance with its NPDES Whole Effluent Toxicity Test Limitation. Because the test organism used in these tests are very sensitive to these metals, it is unlikely that the metals are in a chemical form that is biologically available and therefore it is unlikely that they are causing degradation to the Deep River. Iron is found associated with clay soils within Piedmont North Carolina and also is considered biologically unavailable. In addition, pesticides and organics were found in river samples downstream of the WWTP. Numerous unidentified peaks in pollutant scans suggested the presence of many organic chemicals both in the treatment plant effluent and instream. High Point is required to conduct quarterly whole effluent chronic toxicity tests at 90% effluent strength. In 1993 and 1994 the city failed one test in five. The WWTP is required to conduct an annual pollutant analysis scan (APAM). The results of the past APAMs will be reviewed and chemical specific limits or additional monitoring may be required in order to protect water quality.

Subbasin 07
The Lillington WWTP and Swift Textiles WWTP have been non-compliant with toxicity requirements. Lillington has been fined and is negotiating an SOC for additional time to investigate and determine sources of toxicity in order to achieve compliance. Swift Textiles has undergone intensive study of dye and chemical use to identify sources of toxicity, and has made WWTP improvements without complete resolution of its toxicity problem.

Subbasin 08
A cluster of large bulk petroleum storage and distribution facilities is located at the headwaters of the East Fork of the Deep River. Eleven "tank farms" are currently permitted to discharge

Table 6.12. Oil tank farms within the East Fork Deep River watershed

FACILITY	LOCATION
Amerada Hess	UT East Fork Deep River
Ashland Petroleum Company	UT East Fork Deep River
Colonial Pipeline	UT East Fork Deep River
Conoco, Inc.	UT East Fork Deep River
Exxon Company, USA	UT East Fork Deep River
GNC Energy Corporation	UT East Fork Deep River
Louis Dreyfus Energy Corporation	UT East Fork Deep River
Plantation Pipeline Company	UT East Fork Deep River
Shell Oil Terminal	UT East Fork Deep River
Star Enterprise	UT East Fork Deep River
Triad Terminal Company	UT East Fork Deep River

wastewater from their treatment systems which collect various forms of runoff. These tank farms are located in the watershed for High Point Lake, a public water supply (the East Fork Deep River and Long Branch are classified WS-IV). As a result, a TMDL for phenols (total phenolic compounds) has been established for the lake headwaters. Due to the low to zero flow at the points of discharge, and proximity of a water supply, the amount of phenols allowable at the water supply intake under low flow conditions was divided equally among the discharges. Since the discharges occur at low and mid flows as well as high flow (i.e. after rain events), and since most facilities do not have a design flow, this limit was calculated as an allowable instream concentration (1 ug/l). The allowable concentration was then converted to a mass load, based on the stream flow, and allocated evenly among the discharging facilities.

In 1994, the Aquatic Toxicology Unit completed a study of bulk petroleum storage facilities in North Carolina. The study involved sampling effluent from several such facilities and performing toxicity tests and extensive chemical analyses on the samples. The purpose of the study was to evaluate the different levels and/or types of treatment and management practices employed at the facilities and their ability to meet NPDES permit limits. Two of the storage facilities in the cluster of tank farms at the East Fork Deep River headwaters were evaluated in the study. The study results showed that, when proper treatment and management practices were observed, the facilities were consistently able to produce WET test results that indicated no measurable toxic effects on aquatic organisms. The study also showed that the facilities with oil/water separators and some capacity for stormwater storage prior to discharge were able to consistently meet chemical specific discharge limits for discharges to non-water supply waters. However, the study showed that the facilities discharging to water supply waters had a higher potential to experience occasional violations of the more stringent chemical specific standards for such waters. Several tank farms employ more extensive treatment methods, such as air strippers and carbon absorption, to meet the more stringent water supply standards.

The Division of Water Quality is considering the development of a general NPDES permit for bulk petroleum storage facilities. If tank farm facilities maintain proper treatment systems and on-site management practices, the risk posed to surface water quality by their minimal discharges is negligible. It is also recommended that local emergency management agencies develop extensive contingency plans to protect water supplies in the event of spills, substantial leaks, or any other incidental petroleum product releases.

Subbasin 10

The Star WWTP discharges to Cotton Creek, a zero flow creek with limited assimilative capacity for toxics. Water quality has consistently been rated poor below the WWTP primarily due to the presence of textile salts. The Fayetteville Regional Office and the Town of Star are currently developing a Special Order to resolve the toxicity testing failures. The Town is coordinating efforts with the textile industries to reduce salt loading to the WWTP through reformulation of the textile dyes.

Subbasin 15

<u>Rockfish Creek</u>

Biological sampling was performed on Rockfish Creek in 1990 as part of an investigation to determine the potential for High Quality Waters designation. Below the Raeford WWTP the creek received a Good-Fair rating which rendered it ineligible for HQW classification. At that time the Raeford WWTP was experiencing consistently acidic effluent pH levels (below the lower limit of 6.0 SU), high residual chlorine levels, and occasional toxicity test failures. The facility has since improved performance in all of these areas and most recent sampling, in 1993, resulted in improvement to an Excellent rating for the stream. In May 1994, Rockfish Creek was Rockfish Creek was re-investigated for reclassification to High Quality Waters, but again the waterbody did not meet the requirements for reclassification.

Subbasin 17

Currently a number of discharges to the Cape Fear have received chronic toxicity tests based on an IWC derived from estimates of advective flow which assumes complete mixing, while facilities upstream of them received acute tests on the basis of tidal flushing and mixing. Investigations will be pursued to determine the boundary at which the flow in the river becomes dominated by tidal influences, and the advective flow from upstream becomes "insignificant", or vice versa. Meanwhile the whole effluent toxicity for Arcadian and Wilmington Northside should be changed to acute (24 hr., NSM @ 90%) tests. This change would reflect the tidal nature of the stream at their discharge locations.

For new and expanding discharges in subbasin 17 with acutely toxic discharges to tidal areas, DWQ has begun looking at plume model results to determine initial dilution at the end-of-pipe. This dilution is used to determine toxics limits and dilution for chronic toxicity tests. The facility may improve their near-field dilution by constructing a diffuser. The purpose of the diffuser is to reduce the size of the mixing zone around the effluent pipe.

Subbasins 21 & 22

Mount Olive Pickle Plant discharges 0.4 MGD of treated process wastewater to Barlow Branch, a zero flow tributary of the Northeast Cape Fear River. Due to the high levels of chlorides used in brine solutions to store, process and package pickle products, the facility discharges high chloride concentrations into the receiving stream. Studies conducted by DWQ have shown that the discharge is adversely impacting the stream's biological community, mainly by reducing the diversity of species to a level lower than would be expected in an unaffected stream similar to Barlow Branch.

The facility has completed documentation required to support an application for a variance from the water quality standard for chlorides, and the variance request has been approved by the EMC's NPDES Committee to proceed to public hearing. As part of the variance process, the facility will continue to evaluate and pursue new methods of source reduction and removal technology which can lower the effluent levels of chloride without placing the facility in an economically untenable position.

<u>Panther Branch</u>

Cates Pickles discharges 0.5 MGD of process wastewater with high chloride concentrations to an unnamed tributary of Panther Branch, a zero flow stream that flows to Goshen Swamp. In cooperation with Mt. Olive Pickles, Cates is pursuing a variance to allow a high saline discharge. The water quality concerns and responsibilities of maintaining the variance mentioned above for Mt. Olive Pickles also apply to the Cates discharge.

6.6 MANAGEMENT STRATEGIES FOR CONTROLLING SEDIMENTATION

6.6.1 Overview of Sedimentation Problems in the Cape Fear Basin

Sedimentation is a serious concern in the Cape Fear Basin as indicated in section 3.2.4 of Chapter 3. There are 613 miles of streams thought to be impaired by erosion and sedimentation. Eleven of the 24 subbasins in the basin had 20 or more miles of streams thought to be impaired by sediment (see Table 4.15 in Chapter 4). Each of these subbasins and their respective miles of sediment-impaired streams is listed below by major watershed areas.

Haw River Watershed: subbasins 01 (26 miles), 02 (31 miles), 03 (23 miles) and 05 (38 miles)
Deep River Watershed: Subbasin 11 (58 miles)
Upper Cape Fear River Watershed: subbasins 07 (44 miles) and 15 (50 miles)
Lower Cape Fear River and Coastal Waters: subbasins 16 (54 miles) and 17 (52 miles)
Black River Watershed: subbasin 18 (31 miles) and 19 (27 miles)
Northeast Cape Fear: subbasin 22 (68 miles) and 23 (35 miles)

Sedimentation is essentially a widespread nonpoint source-related water quality problem which results from land-disturbing activities. The most significant of these activities include agriculture and land development (e.g., highways, shopping centers, and residential subdivisions). For each of these major types of land-disturbing activities, there are programs being implemented by various government agencies at the state, federal and/or local level to minimize soil loss and protect water quality. These programs are listed in Table 6.13 and are briefly described in Chapter 5.

Table 6.13 State and Federal Sediment Control-related Programs (with Chapter 5 Section References in Parentheses)

- o <u>Agricultural Nonpoint Source (NPS) Control Programs (Section 5.3.1)</u>
  - North Carolina Agriculture Cost Share Program
  - NC Cooperative Extension Service and Agricultural Research Service
  - Watershed Protection and Flood Prevention Program (PL 83-566)
  - Food Security Act of 1985 (FSA) and the Food, Agriculture, Conservation and Trade Act of 1990 (FACTA) (Includes Conservation Reserve Program, Conservation Compliance, Sodbuster, Swampbuster, Conservation Easement, Wetland Reserve and Water Quality Incentive Program)
- o <u>Construction, Urban and Developed Lands (Sections 5.3.2 and 5.3.3)</u>
  - Sediment Pollution Control Act (Section 5.3.3)
  - Federal Urban Stormwater Discharge Program
  - Water Supply Protection Program
  - ORW and HQW Stream Classifications
- o <u>Forestry NPS Programs (Section 5.3.6)</u>
  - Forest Practice Guidelines Related to Water Quality
  - National Forest Management Act (NFMA)
  - Forest Stewardship Program
- o <u>Mining Act (Section 5.3.7)</u>
- o <u>Wetlands Regulatory NPS Programs (Section 5.3.8)</u>

  The sediment trapping and soil stabilization properties of wetlands are particularly important to nonpoint source pollution control. Several important state and federal wetland protection programs are listed below.
  - Section 10 of the Rivers and Harbors Act of 1899
  - Section 404 of the Clean Water Act
  - Section 401 Water Quality Certification (from CWA)
  - North Carolina Dredge and Fill Act (1969)

6.6.2 Overview of Strategies/Programs to Control Sedimentation

No sediment control measures are 100% effective so some level of sedimentation will occur with land-disturbing activities. Education and promotion of stewardship are keys to reducing sedimentation, along with judicious strengthening of regulations and enforcement.

DWQ's role in sediment control is to work cooperatively with those agencies that administer the erosion and sediment control programs in order to maximize the effectiveness of the programs and protect water quality. Where programs are not effective, as evidenced by violation of instream water quality standards (section 3.2.4), and where DWQ can identify a source, then appropriate enforcement action can be taken. Generally, this would entail requiring the land owner or responsible party to install acceptable best management practices (BMPs). BMPs vary with the type of activity, but they are generally aimed at minimizing the area of land-disturbing activity and the amount of time the land remains unstabilized; setting up barriers, filters or sediment traps (such as temporary ponds or silt fences) to reduce the amount of sediment reaching surface waters; and recommending land management approaches that minimize soil loss, especially for agriculture.
Some control measures, principally for construction or land development activities of 1 acre or more, are required by law under the state's Sedimentation and Erosion Control Act administered by the NC Division of Land Resources (Section 6.6.4). For activities not subject to the act such as agriculture, erosion and sediment controls are carried out on a voluntary basis through programs administered by several different agencies. The NC Agricultural Cost Share Program administered by the NC Division of Soil and Water Conservation provides incentives to farmers to install best management practices (BMPs) by offering to pay up to 75% of the average cost of approved BMPs (Section 6.6.3). A federal Farm Bill program administered by the Soil Conservation Service provides an incentive not to farm on highly erodible land (HEL) by taking away federal subsidies to a farmer that fails to comply with the provision.

Despite the combined efforts of all of the above programs for construction, forestry, mining and agriculture, there were still hundreds of miles of streams in the Cape Fear Basin thought to be impaired by sediment, thus pointing to the need for continued overall improvements in erosion and sediment control. Part of the problem is that no sediment control measures are 100% effective so some sedimentation is expected where land-disturbing activities occur. But there are still additional improvements that can be made as listed below. Education and promotion of stewardship are keys to improvement along with judicious strengthening of regulations and enforcement. The following sections outline some existing and proposed recommendations for addressing sedimentation.

6.6.3 Sedimentation Control Through the NC Agricultural Cost Share Program

The NC Agricultural Cost Share Program funding totals for 1985 through 1994 are presented in Tables 6.14 and 6.15. Table 6.14 presents expenditures by subbasin within the Cape Fear basin. The cost share figures include a wide array of BMPs including conservation tillage, terraces, diversions, critical area plan, sod-based rotation, crop conservation grass, crop conservation trees,

Table 6.14 NC Agricultural Cost Share Program Statistics for Erosion Control in the Cape Fear River Basin (Cumulative totals 1985 -1994)

ACRES	TONS OF	TOTAL	
SUBBASIN	AFFECTED	SOIL SAVED	CONTRACT AMT
03-06-01	5,988	50,445	$628,013
02	11,662	60,103	$1,268,735
03	5,852	34,469	$525,709
04	12,855	75,852	$1,015,135
05	1,714	11,341	$113,957
06	1,009	6,715	$54,719
07	3,361	33,368	$275,502
08	1,101	26,770	$90,811
09	4,735	66,260	$289,792
10	4,586	12,433	$285,588
11	2,167	26,230	$153,024
12	4,401	52,672	$419,036
13	3,823	38,244	$299,604
14	3,312	12,719	$198,749
15	4,064	6,196	$157,371
16	3,807	1,920	$158,637
17	5,447	19,183	$237,539
18	6,318	11,223	$276,365
19	6,501	10,180	$450,708
20	4,540	15,974	$107,229
21	21,465	37,186	$820,207
23	14,587	21,449	$483,312
24	69	730	$48,323
TOTALS	135,547	630,079	$8,697,572

filter strip, field border, grass waterway, water control structure and livestock exclusion. Total expenditures for the entire basin for each approved practice are presented in Table 6.15.

Table 6.15 Cape Fear River Basin BMP Summary 1985 - 1994.

NC EHNR SOIL & WATER 2/02/95 PRACTICE LOG SUMMARY GRAND TOTAL 11:28 am Page 1

Cape Fear River Basin BMP Summary 85-94 (to S. Hoover 2/2/95) Sh

EROSION/NUTRIENT CONTROL GRAND TOTAL

ITEM	UNITS	MSR	COST
Conserve Tillage	16,520.04	A	178,270.50
Terraces	396,253.00	F	139,991.84
Diversions	164,425.50	F	173,631.12
Crtcl Area Plan	539.97	A	303,527.31
Sod-Based Rotatn	16,677.55	A	751,895.43
Stripcropping	9,170.83	A	585,625.35
Crop Cnv Grass	12,493.17	A	1,485,794.13
Crop Cnv Trees	1,310.50	A	142,475.00
Crop Cnv Wldlife	.50	A	57.00
0.00	A	0.00	Lvstock Excl
15.00	N	16,667.00	Nutr Red Mgt

SEDIMENT/NUTRIENT CONTROL GRAND TOTAL

ITEM	UNITS	MSR	COST
Filter Strip	22.52	A	13,754.00
Field Border	679.50	A	553,773.67
Grass Wtrway	812.37	A	1,198,208.03
H2O Ctrl Str	115	N	115,381.00
Heavy Use	14	N	45,656.00
Spring Dvlpmt	8	N	6,015.00
Stock Trail	27	N	68,019.00
Stream Cross	20	N	40,737.00
Trough Tank	34	N	33,872.00
116,574.00	F	62,360.00	
0.00	A	0.00	
Wells	3	N	3,450.00
Pesticide Load	1	N	15,000.00
Portable Wtr Fac	0	N	0.00
Windmills	0	N	0.00
Pesticide Mgmt	0	A	0.00
Sediment Basin	0	N	40,000.00

ANIMAL WASTE MANAGEMENT GRAND TOTAL

WASTE MANAGEMENT

ANIMALS	NUMBER	SYSTEMS	
Cows	13,353	Lagoon	.103
Fish	0	Cost	998,775.00
Hogs	171,029	Ponds	64
Horses	0	Cost	398,416.00
Poultry	6,790,226	Dry Stack	6
Sheep	0	Cost	75,249.00
		Pads	0
		Cost	0.00
		LittrStor	1
		Cost	6,075.00
		Composter	95
		Cost	444,185.00
		Loafing Lot	1
		Cost	231.00
		Abandon CAO	1

LAND APPLICATION

ANIMALS	NUMBER		
Cows	15,826	Acres	40,310.01
Fish	0	Gallons	301,971,219
Hogs	337,161	Tons	329,458.01
Horses	13,515	Cost	1,108,712.20
Poultry	9,943,571	Solid Set	15
Sheep	0	Cost	144,160.00
		Wetlands	0
		Cost	0.00
		Hydrants	19
		Cost	169,604.00
		Mob. Irrig.	0
		Cost	0.00

GRAND TOTAL SUMMARY DATA

Acres Affected	135,547.80
Tons Saved	630,079.00
ASCS Payment	(619,541.00)
Total Contract Amount	8,697,572.58

6.6.4 Sediment Control for Construction Activities

Construction activities are controlled under the Sedimentation and Erosion Control Act administered by the NC Division of Land Resources (DLR). This act requires anyone disturbing more than one acre of land to submit a Sedimentation and Erosion Control Plan to DLR. One of the major requirements is that there are adequate erosion control measures to retain all sediment on a development site during the 25-year storm. Generally, a land owner must install acceptable Best Management Practices (BMPs) when the land is disturbed by construction or development activities. Management practices may include barriers, filters, or sediment traps to reduce the amount of sediment that leaves a site. Under this act, local governments may take responsibility for reviewing and enforcing the Sedimentation and Erosion Control Program within their jurisdiction; however, their program must be at least as stringent as DLR's.

In order to match the pace of land disturbing activity, more staff hours will be needed within the DLR in order to effectively administer and fully enforce the provisions of the Act. At present, planning and inspection staff are stretched thinly across large geographic areas and a wide variety of projects.

The responsibility for controlling sediment from construction activities falls on many shoulders. The parties with the greatest responsibility include: homeowners, developers/contractors, local governments, and the NC Division of Land Resources. Table 6.16 presents actions that will help to address sediment problems associated with construction activities.

Resource materials:

- The following can be ordered from the NC Division of Land Resources at P.O. Box 27687, Raleigh, NC 27611, (919)733-3833:
  1) *NC Erosion and Sediment Control "Planning and Design Manual"* ($55 for in-state, $75 for out-of-state)
  2) *NC Erosion and Sediment Control "Inspector's Guide"* ($20 for in-state or out-of-state)
  3) *NC Erosion and Sediment Control "Field Manual"* ($20 for in-state or out-of-state)
  4) *NC Erosion and Sediment Control "Video Modules"* ($15 for in-state, $50 for out-of-state)

6.6.5 Sediment Control for Private Access Roads

Improperly designed, constructed, and maintained private access roads are a significant source of sediment in the Piedmont and mountains. Often, landowners do not realize the importance of building driveways for lasting service. Some landowners depend entirely on their contractor to design the road. Others try to design it themselves without consulting a reputable source. The consequences of not paying attention to an access road as it is designed and constructed can be serious. In addition to losing the road and potentially losing land and property, the washed-out road can damage water quality. Table 6.17 offers suggestions for addressing these issues.

Most of the responsibility for an access road rests on the landowner. However, local governments, citizens, and state/federal agencies can also make their contribution to solving this problem.

Resources:

- *Guidelines for Drainage Studies,* NCDOT Hydraulic Design Unit (1995). To obtain, call NCDOT at (919) 250-4128.
- *Final Report: Timbered Branch Demonstration/BMP Effectiveness Monitoring Project* by Richard Burns, USDA Forest Service (1994). To obtain, call USDA at (704) 257-4214.

Table 6.16 Recommended Actions to Address Construction-Related Sediment Problems

Homeowners	Fit the development to existing site conditions. Development that follows natural contours and avoids flood plains and highly erodible soils, is much easier to control erosion and sedimentation. Establish, maintain, and protect vegetation beside streams on your property. Buffers provide a filter for sediment and other pollutants. Carefully monitor the construction process. Ensure permanent vegetation is established and maintained on construction site ASAP. Continue to control sediment after construction is complete.
Developers/ Contractors	Fit the development to existing site conditions. Development that follows natural contours and avoids flood plains and highly erodible soil is much easier to control erosion and sedimentation. Minimize the extent and duration of exposure. Schedule construction according to weather and season. Try to pick dry times. Protect areas to be disturbed from stormwater runoff. Use dikes, diversions, and waterways to intercept runoff and divert it away from cut-and-fill slopes or other disturbed areas. To reduce erosion, install these measures before clearing and grading. Keep runoff velocities low. Convey stormwater away from steep slopes to stabilized outlets, preserving natural vegetation when possible. Inspect and maintain control structures during the construction process. If not properly maintained, some erosion control measures can cause more damage than they correct. Retain sediment onsite. Protect low points below disturbed areas. Build barriers to reduce sediment loss. When possible, construct sediment traps before other land disturbing activities. Stabilize disturbed areas as soon as possible after construction. Apply mulch and vegetation to land and line channels for protection. Consider future repairs and maintenance of these measures. Train equipment operators to execute erosion and sediment control practices.
Citizens	Report any serious sediment problems on construction sites. This would include bare soil that has not been stabilized within 30 days, brown or red runoff during a storm, or obviously malfunctioning erosion/sediment controls.
Local Govts. Without Delegated Sediment/ Erosion Control Programs	Educate citizens as to the importance of erosion and sediment control before they begin construction activities. Report any serious problems on construction sites. This would include bare soil that has not been stabilized within 30 days, brown or red runoff during a storm, or obviously malfunctioning erosion/sediment controls. If your resources allow, consider taking responsibility for sediment and erosion control in your jurisdiction. This will allow greater control over implementation and enforcement of the program. It will also offer the opportunity to require sediment control on developments disturbing under one acre. Maintain publicly-owned open space. Will prevent sediment loss from certain tracts of land.
Local Govts. With Delegated Sediment/ Erosion Control Programs	Educate citizens as to the importance of erosion and sediment control. Maintain publicly-owned open space. Will prevent sediment loss from certain tracts of land. Evaluate the effectiveness of current sediment control enforcement. Identify staff resource needs. When possible, coordinate efforts with other agencies such as the Dept. of Transportation, Div. of Forest Resources, and Soil and Water Conservation Districts.
NC Div. of Land Quality	Continue to promote effective implementation and maintenance of erosion and sediment control measures on construction sites. Research innovative new ways to control sediment on construction sites. Evaluate the effectiveness of current sediment control enforcement. Identify staff resource needs. When possible, coordinate efforts with other agencies such as the Dept. of Transportation, Div. of Forest Resources, and Soil and Water Conservation Districts. Encourage more delegated programs by local governments where resources allow, especially in rapidly developing areas.

Table 6.17 Recommended Actions to Address Problems Associated with Private Access Roads

Homeowners	Know the state and local laws, ordinances and regulations about access road construction. Be prepared to pay the cost of constructing a good road that will last. The cost of constructing a road will vary greatly from site to site. The cost may increase due to steep or rocky land, low stability soils, or drainage needs. In the long run, it does not pay to skimp. Avoid steep grades. Sustained grades should not exceed 10% for gravel or crushed stone roads. Make sure the road has adequate drainage. Adequate drainage is necessary to control erosion. The following water sources must be considered: rainfall on the roadbed and cut/fill slopes, overland storm flows from the watershed above the road, and springs or streams intercepted by the road. Use drainage methods that protect water quality. These methods include capture areas to treat runoff and routing runoff parallel to streams. Inspect the road periodically. Check for ruts and dips in the road, the condition of the drainage outlets, and the general condition of the cut and fill slopes. Repair any problems immediately. Any problems with ruts, drainage outlets, bare areas, etc. should be repaired before a small problem turns into a large problem.
Contractors	Watch for signs of subsurface drainage problems before, during, and after construction. Some things to look for include: soils that are gray in color, areas with springs or seeps, low areas, and areas dominated by water-tolerant plants such as alders, black walnut, poplar, cattails, reeds, etc. Road and ground cover should be applied as soon as possible after construction.
Citizens	Report any serious problems with access roads. Some problems to look for include big ruts in the roadway, wash-outs, and clogged drainage outlets. You can report problems to your local government officials. If they are not able to help, contact the regional office of the NC Division of Land Resources.
Local Governments	Require properly designed and constructed roads as part of the building permit process. Institute ordinances requiring proper maintenance of private access roads.
State and Local Agencies	Provide citizens with information about how to properly construct private access roads. Investigate innovative new ways of constructing private access roads while protecting water quality.

6.7 MANAGEMENT STRATEGIES FOR STORMWATER CONTROL

6.7.1 Overview of Stormwater Impacts in the Cape Fear River Basin

A number of studies, including the Nationwide Urban Runoff Program (NURP) sponsored by the US Environmental Protection Agency, have shown that urban stormwater runoff, and the pollutants it carries, can be a significant contributor to water quality impairment. Water quality impairment from growth and development is a major concern in the Cape Fear River Basin. There are 200 miles of streams in the Cape Fear River Basin that are thought to be impaired by urban stormwater. Several streams identified as being at least partially impaired from urban runoff based on DWQ's most recent biological monitoring include the following:

Subbasin 01:	Little Troublesome Creek (Reidsville)
Subbasin 02:	South Buffalo Creek, Horsepen Creek, UT Horsepen Creek, Mile Run Creek (Greensboro)
Subbasin 05:	Northeast Creek, Burdens Cr (Durham)
Subbasin 06:	Morgan Creek, Bolin Creek, Little Creek, Meeting of Waters Creek (Chapel Hill)
Subbasin 08:	UT East Fork Deep River, E Fk Deep River, Richland Creek (High Point) Hasketts Creek (Asheboro)
Subbasin 11:	Big Buffalo Creek, Little Buffalo Creek (Sanford)
Subbasin 15:	Cross Creek (Fayetteville)
Subbasin 17:	Greenfield Lake (Wilmington)

6.7.2 Overview of Stormwater Control Programs

DWQ administers a number of programs aimed at controlling urban stormwater runoff. These include: 1) programs for the control of development activities in the 20 coastal counties, near High Quality Waters (HQW) and Outstanding Resource Waters (ORW) (Section 6.7.3), and activities within designated Water Supply (WS) watersheds and 2) NPDES stormwater permit requirements for industrial activities (Section 6.7.4)and municipalities greater than 100,000 in population (Section 6.7.5 and Section 5.3.2).

6.7.3 Stormwater Controls in HQW, ORW and Water Supply Watersheds

The Cape Fear River Basin includes a number of streams and lakes that are assigned HQW, ORW and WS water classifications (see Section 2.7 in Chapter 2 for locations). Coastal counties in the basin subject to stormwater requirements include Brunswick, New Hanover, Pender and part of Onslow. As described in other parts of this plan, these waters carry with them specific management strategies to protect their uses, including measures to control stormwater runoff from urban development (Section 2.7 and Appendix I). The HQW, ORW and coastal county stormwater requirements in this basin are implemented by DWQ through its Regional Offices (Winston-Salem, Raleigh, Fayetteville and Wilmington). Any development activities subject to the HQW or ORW requirements must submit plans and receive stormwater approvals from these regional offices. The water supply protection requirements are implemented by all local governments that have jurisdiction in a water supply watershed. There are a number of local governments in the Cape Fear basin that have developed water supply watershed protective ordinances for watersheds in the basin. Development activities covered by water supply protection requirements must be reviewed and approved by the appropriate local government.

6.7.4 Recommendations for Controlling Industrial Stormwater

Throughout the Cape Fear River basin various types of industrial activities with point source discharges of stormwater are required to be permitted under the NPDES stormwater program.

These include facilities engaged in industrial activities such as manufacture of ready mixed concrete; asphalt paving mixtures and blocks; furniture and fixtures; stone, clay, glass and concrete products; timber products; apparel and printing; mining activities; and vehicle maintenance activities.

Surface waters can be significantly impacted by stormwater runoff from industrial facilities, particularly those that store or transfer materials out of doors. The types of chemicals, industrial operations and various ancillary sources influence the pollution potential of each individual facility. As such, industrial facilities can reduce stormwater impacts by developing a comprehensive site-specific Stormwater Pollution Prevention Plan (SPPP or Plan) which is based on an accurate understanding of the pollution potential of the site. The Plan provides a flexible basis for developing site-specific measures to minimize and control the amounts of pollutants in stormwater runoff by implementing best management practices (BMPs). With respect to stormwater, the ultimate BMP is the elimination of exposure of any significant materials to rainfall or runoff.

Facilities subject to NPDES stormwater permitting are required to develop and implement a SPPP. The SPPP approach focuses on two major objectives: 1) to identify sources of pollution potentially affecting the quality of stormwater discharges from the facility; and 2) to describe and ensure that practices are implemented to minimize and control pollutants in stormwater discharges from the facility. The basic components of a SPPP include a site plan detailing the facility layout and locations of potential pollutant sources, a stormwater management plan describing materials management practices and feasibility of employing best management practices, a spill prevention and response plan, a preventive maintenance and housekeeping plan, annual employee training and semi-annual facility inspections. The facility SPPP must be periodically reviewed and updated to reflect changes at the facility.

In addition to the SPPP, all permitted facilities are required to perform qualitative monitoring. This monitoring requires the periodic visual inspection of each stormwater outfall. Inspections are performed for parameters including color, odor, clarity, floating and suspended solids, foam, oil sheen, and other obvious indicators of stormwater pollution. Facilities with significant stormwater pollution potential are also required to perform quantitative analytical monitoring.

Like any impervious surface, roadway systems have the potential to generate stormwater runoff problems. Various types of pollutants from the road surface can be carried to surface waters by rainfall. In addition, roadway construction, roadside vegetation management and roadway operation and maintenance activities can contribute to stormwater pollution problems.

The Division of Water Quality is currently working with the NC Department of Transportation (DOT) to finalize a stormwater management permit for DOT activities. This permit will address pollution from stormwater runoff related to roadways, road construction, vegetation management, operation and maintenance and other related DOT activities throughout the state. The major permit requirements are the implementation of a comprehensive stormwater management program, monitoring programs to direct the stormwater program and annual reports to outline the effectiveness and direction of the program.

The initial emphasis of the stormwater programs will be on high volume roadway segments in sensitive water areas such as coastal areas and water supply watersheds. The stormwater management programs will try to locate and characterize pollutant problems and to develop and implement appropriate best management practices to protect surface waters.

6.7.5 Management Strategies For Urban Stormwater Control

Water quality impairment from urbanization is a major concern in the Cape Fear River Basin. Virtually every urban stream sampled by DWQ biologists is found to be impaired, and as land is developed, more streams are impaired. The impacts result from a combination of sedimentation from construction, increased streamflow from more impervious surface areas, and decreased quality of runoff water that contains lawn care products, automobile-related pollutants, fecal coliform bacteria from animals and more.

In the Cape Fear River basin, three municipalities are required to develop urban stormwater programs under the NPDES stormwater requirements because their population exceeds 100,000. These include Greensboro, Durham and Fayetteville/Cumberland County. These programs would cover much of the watershed areas of those seven streams listed above in subbasins 02, 05 and 15. Also, at least two other local governments in the basin have undertaken voluntary stormwater programs including High Point and Chapel Hill.

However, most municipalities in the basin not subject to state or federal urban stormwater requirements but have streams that are being adversely impacted by urban stormwater. The entire community plays a role in controlling the quality and quantity of urban stormwater. And the best time to address urban stormwater impacts are when it is most effective and least costly to do so -- before development occurs. Numerous studies have demonstrated a serious decline in the health of receiving waters when 10 to 15 percent of a watershed is turned into impervious surfaces (Schueler 1995).

Listed below are resource materials available to help communities address the control of urban stormwater runoff on water quality. Table 6.18 provides a list of recommendations for local governments, citizens, businesses, developers, and state agencies in addressing urban runoff. Also, tables 6.19 and 6.20 present recommendations for minimizing the adverse impacts on water quality from yard care activities and home care products.

<u>Resources for Control of Urban Stormwater</u>:

- *Stormwater Management Guidance Manual*, 1993, Cooperative Extension Service
- *Stormwater Management in North Carolina: A Guide for Local Officials*, 1994, Land-of-Sky Regional Council, Asheville, NC (Eaker 1994)
- Stormwater Fact Sheets by Land-of-Sky Regional Council, 1994
  1. *Stormwater Problems and Impacts: Why all the Fuss?*
  2. *Stormwater Control Principles and Practices*
  3. *Stormwater Management Roles and Regulations*
  4. *Local Stormwater Program Elements and Funding Alternatives*
  5. *Municipal Pollution Prevention*
  6. *Managing Stormwater in Small Communities: How to Get Started*
  7. *Maintaining Wet Detention Ponds*
  8. *Plan Early for Stormwater in Your New Development*
  9. *How Citizens Can Help Control Stormwater Pollution*
- *Stormwater Best Management Practices*, 1995, NC Division of Environmental Management.

Table 6.18 Recommendations for Urban Stormwater Control

Local governments	Create public education programs. These programs advise citizens on how to care for their homes, businesses, and neighborhoods while minimizing stormwater pollution. Topics to cover can include environmentally sensitive methods of caring for lawns and vehicles (see Table 6.8). Support stream clean-up programs. Clean-up programs such as Big Sweep remove harmful debris from streams and instill a sense of pride that will protect the waterbody in the long-term. Create and enforce strict penalties for improper waste disposal. In addition, local governments should protect dumpsters by fencing around them and cleaning them regularly. Institute land use planning to protect water quality. Through planning, local governments can reduce flooding by limiting the total area of impervious surfaces and directing runoff into vegetated areas or stormwater control devices. Also, planning can be used to protect surface waters by directing growth away from sensitive areas/waters such as floodplains, steep slopes, wetlands, and water supplies. Review local ordinances pertaining to parking and curb and gutter. Local ordinances often require larger parking lots than are needed. Parking lots should be designed to handle the average parking needs with overflow areas in grass. When possible, it is best to eliminate curbs and gutters to allow runoff to flow off the street or parking lot in sheet flow. Protect open spaces and streamside buffers in and around urban areas. This will preserve recreational areas and significant natural resources near the town or city. Attend stormwater workshops for local government officials. Many agencies like DWQ offer work-shops on stormwater management or reference materials. For more information, contact the DWQ stormwater group at (919)733-5083. Map the storm sewer system. If local governments map inlets, pipes, and outlets that make up their storm drain system, they will be well equipped to identify sources of observed stormwater problems. Offer hazardous waste collection days.
Citizens	Participate in stream clean-up programs. Clean-up programs remove harmful debris from streams and instill a sense of pride that will protect the waterbody in the long-term. An annual Big Sweep event is held each year in September. Stream clean-up is a great service activity for groups such as Scouts, 4-H, Rotary Clubs, etc. Practice environmentally-friendly lawn care. Table 6.19 has a list of suggestions for keeping a green lawn while minimizing harm to the environment. When possible, use less-harmful substances in the home for cleaning or painting. Any time hazardous substances are used, there is a risk that they can enter the water by interfering with the proper functioning of septic tanks, leaking out of sanitary sewers, etc. When possible, use less hazardous substances such as latex instead of oil paint (see Table 6.20). Educate adults and children about how to protect water quality. Educational materials can be obtained from the NC Office of Environmental Education, (919)733-0711. Utilize hazardous waste collection centers for paints, petroleum products, and other chemicals. Never dispose of oil, yard wastes, or other materials in storm drain inlets or dump these materials on lands. Storm drains connect directly to nearby streams without any treatment of the water. Maintain and protect riparian buffers on private property. Buffers provide a critical right of way for streams during storms. When buffers contain the 100-year floodplain, they are an extremely cost-effective form of flood insurance. Buffers remove a wide array of pollutants, including sediment, nutrients, and toxic substances. They can also increase property value. Support your local government's land use planning initiatives.
Developers	Incorporate stormwater management in the planning of projects. Plan developments to reduce impervious areas (roads, driveways, and roofs). Do not build in environmentally sensitive areas such as floodplains and wetlands. (This is also a flood insurance policy.) Maintain natural drainage ways and buffers along streams.

Businesses	Maintain and protect riparian buffers on commercial property. Buffers provide a critical right of way for streams during storms. When buffers contain the 100-year floodplain, they are an extremely cost-effective form of flood insurance. Buffers remove sediment, nutrients, and toxic substances. Cover and contain waste materials. This will prevent runoff from the disposal area from becoming contaminated and polluting the receiving water. Practice good housekeeping. A clean and litter-free facility will promote good water quality. Institute hazardous waste collection sites. Automobile service centers, hardware stores, and other pertinent businesses can institute hazardous waste collection sites for used oil, antifreeze, paint, and solvents.
State and Federal Agencies	Provide technical information about urban stormwater. State and federal agencies should strive to increase their communication with local governments, businesses, and citizens. Create and maintain stormwater wetlands along streams. Like buffers, stormwater wetlands treat stormwater and reduce flows. Stormwater wetlands must be designed and maintained properly to be effective.

Table 6.19 How to Take Care of Your Lawn and Car and Protect Water Quality

If you are caring for...	This is the environmentally-friendly practice.
your lawn	• Use only fertilizers that are needed, based on soil tests and plant needs. • Keep fertilizers off driveways and sidewalks. • Avoid using fertilizers within 75 feet of any waterbody. • If you use a lawn service, request natural rather than chemical management. • Plant hardy, native species that do not require chemical inputs. • Contact your Cooperative Extension Agent for more information.
your vehicle	• Maintain motor vehicles and repair leaks promptly. • Dispose of used motor oil and antifreeze in recycling centers. • Avoid gas tank overflows during refueling.

from S.C. Dept. of Health and Environmental Control, "Turning the Tide" (1995)

Table 6.20 Substitutions for Household Hazardous Substances

Instead of...	Try...
• Ammonia-based Cleaners	• Vinegar + Salt + Water
• Abrasive Cleaners	• Lemon Dipped in Borax or Salt + Baking Soda
• Furniture Polish	• Lemon Juice + Olive Oil
• Toilet Cleaner	• Baking Soda + Toilet Brush
• Oven Cleaner	• Liquid Soap + Borax + Warm Water
• Drain Cleaners	• Boiling Water + Baking Soda + Vinegar
• Upholstery Cleaners	• Dry Cornstarch
• Mothballs	• Cedar Chips or Lavender Flowers
• Window Cleaner	• White Vinegar + Water
• Oil-Based Paints and Stains	• Water-based Paints and Stains

from S.C. Dept. of Health and Environmental Control, "Turning the Tide" (1995)

6.8 MANAGEMENT STRATEGIES FOR CONTROLLING COLOR

The discharge of color is to be regulated such that only such amounts as will not render the waters injurious to public health, secondary recreation, or to aquatic life and the wildlife or adversely affect the palatability of fish, aesthetic quality or impair the waters for any designated uses. However, the practical application of this regulation must take into account the various ways in which color is perceived in the environment. Color in natural waters is rarely the result of one specific chemical, rather a mixture of many dissolved and/or suspended constituents contribute to color. Also, the stream bed and sediments may contribute to color. Because color is perceived differently by different people and in different lighting conditions, no general definition of color impairment can be specified by a simple set of criteria.

DWQ is presently working to develop a color monitoring protocol that will allow specific analyses of color in waters of the State. Because textile industries are a significant source of color to waters of the North Carolina including the Cape Fear River Basin, DWQ plans to meet with the North Carolina Textile Manufacturing Association to develop appropriate methodologies for color analysis. This will be followed with a monitoring program with the goal of developing treatment strategies for facilities that are a significant source of colored effluent. Two subbasins that make up the South Fork Catawba River watershed have been targeted in a pilot study to address color. A number of facilities including those in the Cape Fear Basin listed below have been identified for participation in future color monitoring (Table 6.21).

Table 6.21 Facilities identified for color monitoring program.

facility	stream	subbasin
Reidsville	Little Troublesome Creek	03-06-01
Cone Mills	North Buffalo Creek	03-06-02
Burlington East	Haw River	03-06-02
High Point East	Richland Creek	03-06-08
Star WWTP	Cotton Creek	03-06-10
Stevecoknit	Little Rockfish Creek	03-06-22
Guilford East	NE Cape Fear River	03-06-22

6.9 MANAGEMENT STRATEGIES FOR CONTROLLING FECAL COLIFORM

Fecal coliforms are bacteria typically associated with the intestinal tract of warm-blooded animals and are widely used as an indicator of the potential presence of disease-causing bacteria and viruses. They enter surface waters from a number of sources including failing onsite wastewater systems, broken sewer lines, improperly treated discharges of domestic wastewater, pump station overflows, and runoff carrying livestock and wildlife wastes.

Based on evaluation of fecal coliform data from 69 ambient water quality monitoring sites throughout the basin (monitoring stations sampled by DWQ once a month), 10 sites were found to have bacteria counts where the geometric mean of all samples (minimum of 10 samples) over the last five years exceeded the state standard of 200 / 100 ml. These sites include:

Subbasin 01:	Little Troublesome Creek at SR 2600 near Reidsville (Rockingham County)
Subbasin 02:	Reedy Fork at Ossipee (Alamance County)
"	Haw River at Haw River (Alamance County)
"	Town Branch at SR 2109 near Graham (Alamance County)
"	North Buffalo Creek near Greensboro (Guilford County)
Subbasin 05:	New Hope Creek near Blands (Durham County)
"	Northeast Creek near Nelson (Durham County)

Subbasin 08:	East Fork Deep River at SR 1541 near High Point (Guilford County)
"	Muddy Creek at SR 1936 near New Market (Randolph County)
Subbasin 09:	Deep River at SR 2128 at Worthville (Randolph County)

Also, for the last two years, the Town of Star WWTP in subbasin 10, has been exceeding its fecal coliform limit by extraordinary counts; bacteria counts have consistently been in the thousands and up to 760,000/100 ml in the effluent. These counts are directly affecting the instream fecal coliform levels. Measures have been taken to reduce fecal levels in the effluent. The Town of Star has received fines for the above permit violations and treatment has improved recently.

In addition, approximately 4,800 acres of shellfish (SA) waters in the estuarine portion of the basin have been closed to harvesting by the NC Division of Environmental Health's Shellfish Sanitation Branch due to elevated levels of bacteria. The fecal coliform bacteria standard for shellfish waters is 14/100 ml. Nonpoint sources are reported to be the pollution source for 78% of the impaired estuarine waters with point sources accounting for the remaining 22%. Probable sources of the fecal coliform contamination include urban runoff, failing septic tanks, agriculture, marinas and improperly operating wastewater treatment plants.

Several general recommendations for addressing fecal coliform contamination in both fresh and estuarine waters include:

- Proper maintenance of onsite waste disposal systems (such as septic tanks).
- Maintenance and repair of sanitary sewer lines by WWTP authorities.
- Elimination of direct unpermitted discharges of domestic sewage wastes (also known as "straight pipes") from homes and businesses to streams or stormwater systems.
- Proper management of livestock to keep wastes from reaching surface waters.
- Encouragement of local health departments to routinely monitor waters known to be used for body contact recreation (e.g., swimming and tubing). DWQ has classified 272 miles of streams for primary water contact.

In coastal waters, a major hurdle in controlling fecal coliform contamination and reopening closed shellfish waters has been in identifying the specific sources of bacterial pollution and then ensuring implementation of effective control measures. Because of the high costs of treatment (e.g. replacement of septic systems with centralized wastewater treatment systems or installation of BMPs in urban or agricultural areas), there has been a reluctance to require control measures without being able to document specific sources. However, documentation of sources requires expensive and time-consuming monitoring, and there is little money and insufficient staff time and resources available to pinpoint sources "beyond a reasonable doubt". And third, even when a source has been identified, control of bacteria to meet shellfish water standards may be extremely difficult as in the case of runoff from densely developed areas.

Clearly, if the continued closure of shellfish waters is to be prevented, and the reopening of closed shellfish waters is to be accomplished, there needs to be a concerted effort by state, local and federal government agencies, cooperation of landowners and support by the state legislature to make it happen. Such an effort will require funding, staff time, public education, and probably new regulations aimed clearly at controlling fecal coliform bacteria in the area of shellfish waters. The basinwide planning process is not empowered with the authority to require these actions, however, it does offer the opportunity to draw attention to this issue and to set into motion actions that may lead to positive results.

DWQ has targeted several fecal-coliform impaired coastal water bodies in the Cape Fear Basin in which localized watershed-based planning will be needed to begin to effectively address the problems: Bradley Creek, Howe Creek, Pages Creek, Futch Creek, Virginia Creek, and Mill Creek.

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